

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
28 December 2000 (28.12.2000)

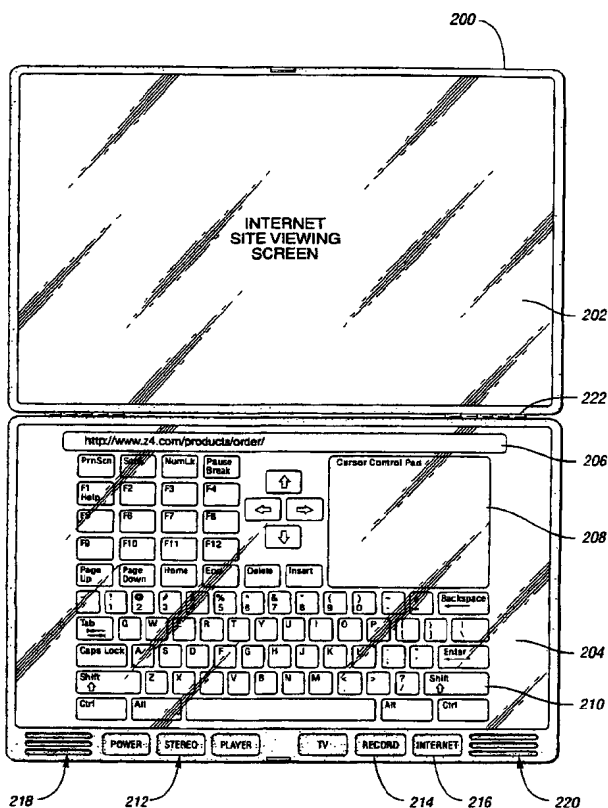
PCT

(10) International Publication Number
WO 00/79372 A1

- (51) International Patent Classification⁷: G06F 3/00, G09G 5/00
- (21) International Application Number: PCT/US00/40264
- (22) International Filing Date: 21 June 2000 (21.06.2000)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
60/140,218 22 June 1999 (22.06.1999) US
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- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
- Published:
— With international search report.

[Continued on next page]

(54) Title: PERSONAL DIGITAL ASSISTANT WITH MULTIPLE DISPLAYS



(57) Abstract: An electronic device (200) having a plurality of displays (202, 204) connected by a folding coupling, such as a hinge (222) includes at least one display (204) that may be configured for receiving input and/or providing output to a user. The displays are preferably physically discrete but may be controlled to function as a single display with respect to scrolling text, etc. Each display may be separated into multiple display areas by an appropriate overlay or other suitable separation if desired. The displays may be of any conventional type such as an active matrix, LCD and/or a variety of touch pads or panels. The device is usable as a PDA for exchanging email or browsing the Internet but may also be configured for variety of functions including a calculator, audio/video player/recorder, and the like.

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PERSONAL DIGITAL ASSISTANT WITH MULTIPLE DISPLAYS

TECHNICAL FIELD

5 The present invention relates to a portable electronic device having multiple displays with at least two displays coupled by a foldable connector such as a hinge.

BACKGROUND ART

Personal digital assistants (PDAs) have become increasingly sophisticated as microprocessor and memory technology has made low-power hand-held computing devices readily available at prices consumers are willing to pay. 10 Currently available PDAs typically include a touch-sensitive LCD screen which functions as both an input and output device to receive data/commands from a user and display requested information. Some PDAs also include a dedicated input area which may be used for entering data and commands that may recognize letters, numbers, or other characters. A detachable cover may be provided to protect the 15 display and/or dedicated input area from unwanted scratches, dirt, and entry of unintended data/commands while the PDA power is on.

Designers of hand-held computing devices, such as PDAs, must balance the user's desire to maximize usefulness and functionality of the device while maintaining a portable and attractive form factor. As features are added, the devices 20 may become more difficult to use as input and output buttons, switches, dials, and displays become smaller and denser to maintain or reduce the overall package size while providing a device which is large enough for hand-held use and small enough to carry in a pocket or purse, for example. As such, it is desirable to provide an efficient user interface that effectively utilizes available surfaces for input and output 25 functions without detracting from the functionality or appearance.

Wireless communication technology incorporated into hand-held computing devices, such as PDAs, has afforded users the opportunity to "stay

connected" while away from their desk or office. Infrared (IR), radio-frequency (RF), cellular, and satellite communication allow users to receive email, exchange business cards, synchronize appointment schedules, and browse the Internet, for example. While these features may be available for hand-held computing devices, their use is limited by the display capabilities of the devices. In particular, the limited size of the display screens on hand-held computing devices typically requires reformatting of the information by the supplier, and/or ongoing manipulation of the display by the user in the form of paging and/or scrolling up, down, left, and right.

DISCLOSURE OF INVENTION

Thus, it is an object of the present invention to provide a hand-held computing device having multiple display screens.

Another object of the present invention is to provide a PDA having at least two display screens connected by a foldable coupling, such as a hinge.

A further object of the present invention is to provide a hand-held computing device having at least two displays with at least one being selectively configurable as an input and/or output device.

Another object of the present invention is to provide a hand-held computing device having multiple discrete displays functioning as a single continuous display.

A still further object of the present invention is to provide a hand-held computing device having at least two LCD displays connected by a hinge.

Another object of the present invention is to provide a hand-held computing device having multiple displays for enhanced Internet functionality.

In carrying out the above objects and other objects, features, and advantages of the present invention, a hand-held computing device includes a housing having a first display, a processor, and a memory with the processor being

in communication with the first display and the memory, and a cover connected to the housing by a foldable coupling wherein the cover includes a second display in communication with the processor which generates output signals to display information on the first and second displays.

5 According to the invention, there is provided an electronic device having a plurality of displays connected by a folding coupling, such as a hinge. At least one of the displays may be configured for receiving input and/or providing output to a user. The displays are preferably physically discrete but may be controlled to function as a single display with respect to scrolling text, etc. Each
10 display may be separated into multiple display areas by an appropriate overlay or other suitable separation means if desired. The displays of the present invention may be of any conventional type such as an active matrix, liquid crystal display (LCD) and/or a variety of touch pads or panels. The displays may, of course, also be monochromatic, color, or any other suitable type depending upon the application.

15 The electronic device is preferably powered by a conventional power system which may include, for example, rechargeable batteries (alkaline, lithium, etc.) and/or a direct power coupling such as an alternating current (AC) line via conventional AC/DC adapter (internal or external). Depending upon the application, the electronic device may also be powered by conventional non-rechargeable
20 batteries or any other suitable power source, such as solar power, for example. The electronic device preferably uses one or more processors or central processing units (CPUs), the selection of which will depend on the functions desired for the electronic device. Processors such as, for example, the Intel® family of processors including any of the Pentium® or Celeron® processors may be included in the electronic
25 device to selectively configure the multiple displays as input and/or output devices.

 The present invention includes a number of advantages relative to prior art PDAs. For example, the present invention provides a portable electronic device with sufficient display area to reduce the necessity to constantly page/scroll through data for common tasks such as reading email or browsing the Internet. The
30 configurable nature of one or more displays makes efficient use of the available

surfaces to maintain an acceptable form factor while providing ease of use through touch-sensitive panels within a display and/or externally accessible buttons.

5 The above advantages, and other advantages, objects, and features of the present invention are readily apparent from the following detailed description of the best mode for carrying out the invention when taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

10 FIGURE 1 illustrates a personal digital assistant having multiple displays connected by a foldable coupling, such as a hinge, for one embodiment according to the present invention;

FIGURE 2 illustrates a hand-held computing device with multiple displays connected by a hinge configured as a computer in one embodiment according to the present invention;

15 FIGURE 3 illustrates a hand-held computing device with multiple displays connected by a hinge configured as a calculator in one embodiment according to the present invention;

FIGURE 4 illustrates another embodiment of a hand-held computing device with multiple displays connected by a hinge configured as a calculator according to the present invention;

20 FIGURE 5 illustrates an alternative PDA having dual displays connected by a hinge configured for Internet browsing according to one embodiment of the present invention;

25 FIGURE 6 illustrates another embodiment of a hand-held computing device having multiple displays configured for display of a digital video according to one embodiment of the present invention;

FIGURE 7 illustrates another embodiment of a hand-held computing device with dual displays connected by a hinge configured as a computer for receiving a digital data module to configure the device for Internet browsing according to one embodiment of the present invention;

5 FIGURE 8 illustrates a hand-held computing device having dual displays connected by a hinge which is configurable as a computer with an appropriate computer module according to one embodiment of the present invention;

10 FIGURE 9 is a block diagram illustrating various internal components of a hand-held computing device with multiple displays according to the present invention;

FIGURE 10 illustrates a hand-held computing device with multiple displays configured as an audio player for streaming audio, stored audio, or radio broadcast listening according to one embodiment of the present invention;

15 FIGURE 11 illustrates an alternative embodiment of a hand-held electronic device with dual displays connected by a hinge for displaying digital video according to one embodiment of the present invention;

FIGURE 12 illustrates a hand-held electronic device with multiple displays connected by a hinge configured in a television mode according to one embodiment of the present invention;

20 FIGURE 13 illustrates a hand-held electronic device with multiple displays connected by a hinge configured as a recorder according to one embodiment of the present invention;

25 FIGURE 14 illustrates a hand-held electronic device with multiple displays connected by a hinge with an optional external antenna for exchanging information according to one embodiment of the present invention;

FIGURE 15 illustrates various input/output ports and controls for a hand-held electronic device with multiple displays connected by a hinge according to one embodiment of the present invention; and

FIGURE 16 is a block diagram illustrating operation of a system and/or method for exchanging data with a hand-held electronic device with multiple displays according to the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring now to Figure 1, a personal digital assistant having multiple displays connected by a foldable coupling, such as a hinge, according to one embodiment of the present invention is shown. Portable electronic device 20 includes a housing 22 having a first display 24 and a cover 26 having a second display 28. Cover 26 is connected to housing 22 by a foldable coupling indicated generally by reference numeral 30. In one embodiment, foldable coupling 30 includes at least one hinge 32 which connects housing 22 to cover 26. Device 20 preferably includes input means 34 for selectively controlling functionality of the device. In the embodiment illustrated in Figure 1, input means 34 preferably includes a plurality of directional keys 36, a power key 38, and an enter key 40. As will be appreciated by those of ordinary skill in the art, input means 34 may also include one or more touch-sensitive input devices, dials, switches, and the like.

Portable electronic device 20 preferably includes a processor (best illustrated in Figure 9) in communication with first display 24, second display 28, and input means 34 via appropriate foldable electrical connecting means which extends through foldable coupling 30 to connect at least one of the displays to the processor. In one embodiment, electrical communications means extends between housing 22 and cover 26 through at least one hinge 32 and is preferably, but not necessarily, hidden within at least one hinge 32.

As described in greater detail below, displays 24 and 28 may be selectively configured by the processor to perform various functions including input and/or output functions. For example, as illustrated in Figure 1, display 28 is

selectively configured to provide electronic data, such as an appointment schedule 42, for viewing by a user. One or more of the multiple displays may be selectively configured with several portions having similar or different functions in keeping with the present invention. For example, display 24 as illustrated in
5 Figure 1 includes a first portion 44 configured to display various menu items 50 and a second portion 46 which displays various command or function keys such as keyboard keys 48. Display 24 may include a physical overlay to separate various portions of the screen. Alternatively, portions 44 and 46 may be separated by displaying separating lines or blacking out a portion of the display electronically.

10 Displays 24 and 28 are preferably discrete displays and may utilize any conventional technology including LCD screens, active matrix displays, and the like. Likewise, displays 24 and 28 may be mono-grammatic or color. With the displays selectively configured as illustrated in Figure 1, the hinged design of the present invention permits the display of approximately twice the amount of
15 information relative to a conventional electronic organizer or PDA. As illustrated in Figure 1, displays 24 and 28 may provide different input and/or output functions. Alternatively, the processor may control displays 24 and 28, or adjacent portions thereof, to function as a single continuous display with text scrolling between the bottom of display 28 to the top of display 24, for example. In addition, when
20 functioning as an input device, displays 24 and 28 are preferably touch-sensitive or utilize appropriate touch-sensitive sensing technology associated with housing 22 and cover 26 to detect user input or responding to displayed menus 50 or keys 48.

As described above, the present invention overcomes the limitations associated with conventional electronic organizers which utilize a single display and
25 reduces the frequency of paging and/or scrolling required to view electronic information such as when reading email or browsing the Internet. As will be appreciated by one of ordinary skill in the art, the flexibility afforded by multiple displays allows device 20 to be implemented with an acceptable form factor for hand-held use while maintaining functionality and usefulness. Depending upon the
30 particular application or mode of operation, displays 24 and 28 may operate independently or may function cooperatively as a single display. For example, display 28 may be maintained while the user performs various functions associated

with display 24. While functioning under separate control, display 28 may be paged or scrolled separately from display 24. When using electronic device 20 to browse the Internet, display 24 may be used to display a website while display 28 provides a separate list of links associated with a particular website, for example.

5 Referring now to Figure 2, a hand-held computing device with multiple displays connected by at least one hinge configured as a computer according to one embodiment of the present invention is shown. Device 70 includes a housing 72 having a base portion 74 connected to a cover portion 76 by a plurality of hinges 78, 80. Base portion 74 includes at least one display 82 connected by
10 hinges 78, 80 to at least one additional display 84 in cover portion 76. As illustrated in Figure 2, base portion 74 and/or cover portion 76 may include multiple displays or display sections. For example, base portion 74 includes a dedicated input/output section indicated generally by reference numeral 86. Dedicated input/output section 86 may include one or more physical buttons 88 in addition to an
15 alphanumeric display 90. Physical buttons 88 may have dedicated functions or may be selectively configurable by the processor to implement soft keys, for example. When implemented as soft keys, physical keys 88 preferably include an associated display section for each physical key.

Display 82 and/or display 84 may include one or more sections or
20 portions configurable for a particular function. For example, as illustrated in Figure 2, display 82 includes a cursor control portion 92 which is separated from a keyboard portion 96 by an electronically displayed border 94. Cursor control portion 92 may be operated with a finger or stylist to control movement of an associated cursor displayed on screen 82 and/or screen 84. Likewise, cursor control
25 portion 92 may be used to select or "click" items highlighted by a cursor. In one embodiment, display 82 also includes directional control keys 98 which may also be used to control cursor position or movement.

Cover portion 76 of housing 72 may also include a plurality of
physical keys 100 used to control display 82, display 84, and/or the function of
30 device 70. For example, physical keys 100 may include a power switch 102 and one or more function or mode keys 104, 106, and 108 which may be used to select an

operating mode for device 70. In the example illustrated in Figure 2, button 104 functions as a soft key with its associated function displayed on display 82 or display 84. The associated function is selectively configurable depending upon the mode of operation of device 70. Button 106 corresponds to a dedicated function which selects a computer configuration for device 70 while button 108 corresponds to a dedicated function key which selects the calculator mode of operation for device 70. Screen control keys 110 may be used to page or scroll information on display 82 and/or display 84. These keys may include a slow or single page forward key 112 and a fast or multiple page forward key 114, for example. Similar keys may be provided for paging/scrolling in the opposite direction as illustrated in Figure 2.

Referring now to Figure 3, a hand-held computing device with multiple displays connected by a hinge configured as a calculator according to one embodiment of the present invention is shown. A portable hand-held electronic device 118 includes a first display 120 which may include first portion 122, second portion 124, and third portion 126 separated by a physical overlay 128. In this embodiment, first portion 122 provides a display for graphical and/or statistical output when electronic device 118 is used in a calculator mode or configuration. Overlay 128 may be selectively removed in some embodiments to provide greater flexibility. The second portion 124 of display 120 may be used to display the contents of one or more registers or memories, for example. Likewise, third portion 126 may be used to display a current output, for example.

Preferably, hand-held portable electronic device 118 includes a second display 130 having a first portion 132 and a second portion 134 separated by overlay 136 which forms a part of the base portion 144 of housing 146. Cover portion 148 of housing 146 is preferably connected to base portion 144 via one or more foldable coupling means 148. Coupling means may be formed of any foldable material which preferably is capable of carrying electrical connection means which provide an electrical connection between the processor (not specifically illustrated), display 120 and display 130.

In the embodiment illustrated in Figure 3, display 130 disposed within base portion of housing 146 is selectively configurable to display one or more function keys 138 and a numeric keypad 140. Function keys 138 and numeric keypad 140 are preferably touch-sensitive and may be activated by the user's finger or a stylus, for example.

The portable hand-held electronic device 118 preferably includes a plurality of dedicated function keys, indicated generally by reference numeral 142, which may include a dedicated numeric keypad 150, a paging key 152, and an enter key 154, for example. In addition, the cover portion may also include one or more dedicated and/or selectively programmable keys 156 which control paging, scrolling, and/or the configuration or function of device 118.

Figure 4 illustrates another embodiment of a hand-held computing device with multiple displays connected by a hinge configured as a calculator according to the present invention. Device 160 preferably includes a first screen 162 disposed within top portion 164 and a second display 166 disposed within bottom portion 168. Display 162 preferably includes a number of configurable display areas including area 170 for graphical and/or statistical outputs when using device 160 as a calculator. In addition, display areas 172, 174, 176 and 178 may be used to display various registers or memories, for example. Likewise, display area 180 may be used to display a particular result. Display areas 170-180 are preferably part of a single monolithic display 162 and are separated by separating means 182 which are preferably also generated by display 162. In this example, separating means 182 include various lines, boxes, etc. to separate the various functional areas of display 162. Display 162 and display 166 are preferably connected by a plurality of hinges 184. Unlike the device illustrated in Figure 3, the device illustrated in Figure 4 includes only a single dedicated function key 186 which operates as a power key in this embodiment.

Display 166 is preferably configured to display a plurality of function keys 188, a numeric keypad 190, and a second set of function keys 192. Display keys 188, 190, and 192 are preferably touch-sensitive and may be activated using a stylus, for example. Displays 162 and 166 preferably utilize conventional touch-

sensitive technology which may be incorporated into the display and/or into the surrounding housing. As will be appreciated by one of ordinary skill in the art, device 160 may be a dedicated device which performs a single function, such as that of a calculator, organizer, or the like. Alternatively, the device may be configurable
5 as explained in greater detail below.

Referring now to Figure 5, an alternative PDA having dual displays connected by a hinge configured for Internet browsing according to one embodiment of the present invention is shown. PDA 200 includes a first display 202 which may be used for viewing an Internet website, for example. In addition, device 200
10 includes a display 204 which may include a number of display windows or portions selectively configurable as input or output devices. In this embodiment, display 204 may include an address window 206 which displays any current command or address. In this regard, address window 206 provides an input means for accessing the Internet. In addition, a cursor control pad 208 may be used as an input device
15 to control a cursor displayed on screen 202. In addition, screen 204 may include a touch-sensitive keypad 210 and various other selectively configurable input keys depending upon the particular application and/or mode of operation of device 200. Likewise, cursor control pad 208 and keypad 210 are representative of input means for accessing the Internet.

20 Dedication function keys 212 provide various functions which may be selectively reconfigured by the processor of PDA 200. Function keys may include a dedicated "record" function 214, Internet function 216, and the like. Preferably, PDA 200 includes at least one speaker 218. An additional speaker and/or microphone 220 may be provided for stereo listening and/or recording.

25 As with the embodiments of the present invention illustrated and described with reference to Figures 1-4, display 202 and display 204 are preferably connected via a foldable coupling 222 which is preferably one or more hinges. By using multiple displays connected by a foldable coupling, such as hinges, the present invention provides a personal digital system which can be used for browsing the
30 Internet, sending and receiving e-mail, and the like. More efficient utilization of the available surface area provides a functional device with a portable, hand-held form

factor. As will be recognized by one of ordinary skill in the art, device 200 may include or incorporate various types of multimedia functionality such as telephone, cable, satellite, and/or other wireless communication functions.

Figure 6 illustrates another embodiment of a hand-held computing device having multiple displays configured for display of a digital video according to one embodiment of the present invention. Device 230 includes a first display 232 disposed within cover 234 and a second display 236 disposed within base 238. Cover 234 and base 238 are connected by a foldable coupling which includes hinges 240 and 242. Base 238 includes a power switch 244 and a plurality of speakers 246, 248. Display 236 is configured to provide various input function keys 250 and an output display 252.

For the embodiment of Figure 6, PDA 230 may be used to view digital movies, for example. Display 232 functions as a video output screen to display the digital video information, while display 236 functions as an input/output device to control display 232 and/or the function of device 230. Of course, function keys 250 may be replaced by one or more dedicated and/or selectively programmable keys disposed within cover 234 and/or base 238.

Referring now to Figure 7, an alternative embodiment of a hand-held computing device with dual displays connected by at least one hinge configured as a computer for receiving a digital data module to configure the device for Internet browsing according to one embodiment of the invention is shown. Device 260 includes a first display 262 connected by hinges 264 to a second display 266. Device 260 preferably includes a port 268 for receiving a computer-readable storage medium 270 which may be used to configure device 260 or provide digital information for viewing, listening, etc. Preferably, computer-readable storage medium 270 is selectively removable and includes data and/or instructions executable by the processor of device 260 to control the functionality of the device and/or provide data for manipulation or display.

Device 260 preferably includes stereo speakers 272 and a dedicated power switch 274. In addition, display 266 preferably includes various viewing

function keys 276, an alphanumeric keyboard 278, user programmable function keys 280, an address window 282, a cursor control pad 284, and directional keys 286. As with the embodiments illustrated in Figures 1-6, the embodiment illustrated in Figure 7 may have the keyboard and control function keys of display 266
5 interchanged with the viewing screen of display 262 without departing from the spirit or scope of the present invention.

Figure 8 illustrates a hand-held computing device having dual displays connected by a hinge which is configurable as a computer with an appropriate computer module according to one embodiment of the present invention. Device 300
10 includes a first display 302 connected to a second display 304 by at least one hinge 306. A port 308 is provided for receiving a computer-readable storage medium or module 310 to provide data and/or instructions to configure device 300. As illustrated in the embodiment of Figure 7, port 308 may be positioned in base 312 and/or cover 314 depending upon the particular application.

Referring now to Figure 9, a block diagram illustrating various internal components of a hand-held computing device for use as a PDA with multiple displays according to the present invention is shown. PDA 330 includes a base 332 and cover 334 having displays 336 and 337, respectively. The multiple displays are preferably connected by a foldable coupling, such as a hinge 338, which may conceal
20 electrical connection means 340. PDA 330 may include a programmable function module 342 which includes a computer-readable storage medium for storing data and/or instructions for processor/memory 344. As such, function module 342 is in selective communication with processor/memory 344 by inserting into an appropriate port in PDA 330.

Processor/memory 344 also preferably communicates with various inputs/outputs and controls 346 which may include a transceiver for wirelessly transmitting and receiving digital data as described in greater detail below. Primary drive 348 is in communication with processor/memory 344 via a conventional address/data bus. Primary drive 348 may include any of a number of known
30 computer-readable storage media for persistent or permanent storage of data and instructions used by processor/memory 344 to selectively configure PDA 330 for

various modes as described and illustrated in the Figures. Depending upon the particular processor utilized, a fan 352 may be provided for proper cooling of the electronic components within cover 334 and/or base 332.

5 Displays 337 and 336 preferably include corresponding input/output driver circuitry 354 and 356, respectively, in communication with processor/memory 344. The input/output drivers are used to generate the appropriate signals to drive the displays and/or portions of the displays which may include touch-sensitive areas as described herein. As such, processor/memory 344 may be used to selectively configure display 336 and/or display 337 as an input and/or output device. For
10 example, display 336 may be configured as an input device using driver 356 supplied with appropriate commands/signals by processor/memory 344 to display a keypad or keyboard on display 336. Input/output driver 356 is operable to detect a touch from the user and/or pointing device, such as a stylus, and generate appropriate signals to be processed by the software stored in processor/memory module 344
15 and/or function module 342. Display 337 may be selectively configured with one or more input and output areas with input/output driver 354 used to generate appropriate signals corresponding to the programmed functions.

 As also illustrated in Figure 9, PDA 330 may include an appropriate latching mechanism 362 with a corresponding receiver or receptacle 364 to maintain
20 the hinged base 332 and cover 334 in a closed position. These latching means may be implemented using a mechanical latch, a magnetic and metal latch, or the like. Preferably, any magnetic device is positioned a sufficient distance based on its electromagnetic field to avoid interference with computer-readable storage media in function module 342, primary drive 348, and various other electronic components.

25 PDA 330 preferably includes a conventional power supply system which includes a power adapter 358 in communication with a power storage device, such as battery 350. In addition, a power switch 360 controls activation of device 330 and is preferably in communication with battery 350 and processor/memory 344. Battery 350 preferably provides a low voltage DC power source for PDA 330 and
30 may be implemented using conventional battery technology including rechargeable and disposable batteries and/or combinations thereof. For example, battery 350 may

include one or more nickel-cadmium or lithium ion batteries, alkaline batteries, and the like. Power receptacle 358 may also include an internal adapter/converter to convert AC power to DC power for supply to PDA 330 and/or to recharge battery 350. Of course, an external transformer or converter may be used with a simple
5 jack represented by block 358.

With continuing reference to Figure 9, block 346 provides an interface to selectively exchange information with one or more devices similar to device 330, for example. In one embodiment, block 346 represents a physical data port capable of receiving an appropriate cable to exchange information with a base unit, another
10 PDA, a computer, or the like. Alternatively, or in combination, block 346 may also include a transceiver for wirelessly transmitting and receiving data. Any of the conventional wireless technologies may be utilized in keeping with the present invention. For example, infrared (IR), radio-frequency (RF), optical, and various other communication strategies may be utilized. Likewise, device 330 may be
15 utilized in a cellular, satellite, or other wireless network to transmit and receive information necessary for various functions such as sending/receiving e-mail, browsing the Internet, downloading or viewing/listening to video/audio files, and the like.

Function modules 342 may control the function of PDA 330 or may
20 include digital information to be played/displayed by PDA 330. For example, in one embodiment, a function module 342 includes software and associated data to selectively configure PDA 330 to operate as a calculator. Another function module 342 may be used to selectively configure PDA 330 to operate as a digital video player, for example. Those of ordinary skill in the art will recognize various other
25 functions which may be performed by providing a removable function module such as illustrated in Figure 9.

Referring now to Figure 10, a hand-held computing device with multiple displays configured as a digital audio player for streaming audio, stored audio and/or radio broadcast playing and recording according to one embodiment of
30 the present invention is shown. PDA 400 includes a first display 402 and second display 404 connected via hinges 406. Display 402 is preferably disposed within

cover 408, while display 404 is preferably disposed within base 410. PDA 400 is preferably selectively configurable as a personal digital entertainment device which may be used for listening to digital audio with a graphical representation depicted in area 416 of display 404 and may include corresponding video output on display 402.

5 PDA 400 may include one or more physical keys 412 used to provide control of displays 402 and 404 and/or as to control the function of device 400. Keys 412 may be dedicated keys with fixed functions and/or soft keys with programmable functions based on the device configuration. Alternatively, base 410 or cover 408 may include one or more keys which are user programmable. Display
10 404 also includes function keys 418 to control the volume of speakers 414 and tuning of the PDA 400 to select an appropriate address or radio station, for example. In addition, various display windows 420 may be used to provide the user with associated information such as the date, time, radio station or address, and the like. Device 400 may also include a graphic equalizer with associated control keys 422.

15 Figure 11 illustrates an alternative embodiment of a hand-held electronic device with dual displays connected by a hinge for displaying digital video according to one embodiment of the present invention. Device 450 includes a first screen 452 which may function as a video output screen, for example, and a second screen or display 454 which may provide associated inputs and/or outputs, for
20 example. Displays 452 and 454 are preferably connected by a plurality of hinges 456. Display 454 is preferably selectively configured by the processor to display various user information in associated output windows such as window 458. In addition, display 454 displays representations of function buttons or keys 460 with associated information or labels 462. For example, buttons 460 are preferably
25 touch-sensitive and provide forward and reverse tracks or channels, and volume control, for example. Informational displays or labels 462 are not touch-sensitive and provide information relative to touch-sensitive display buttons 460. In addition, display 454 may include combined labels/touch-sensitive buttons 468. Device 450 may also include physical buttons 464 and preferably includes stereo speakers 466
30 to provide audio output to the user.

Figure 12 illustrates a hand-held electronic device with multiple displays connected by a hinge configured in a television mode according to one embodiment of the present invention. Device 500 preferably includes a base portion 502 with associated display 504 and a cover portion 506 with an associated display 508. Preferably, base portion 502 and cover portion 506 are connected by one or more hinges 510. Display 504 may be selectively configured to display various controls and provide information to the user. Likewise, display 508 may be used to provide controls for either of the displays 504, 508, but is preferably used to provide video output for television viewing. As such, control and information provided on display 504 may include various television controls and informational displays. For example, portion 512 of display 504 may be used to display the current channel with portions 514 having a numeric keypad which is touch-sensitive to change channels or select another address or site for viewing. Likewise, various controls are provided to set the date and time, control the channel, and/or control the volume. Of course, various other menus and/or controls may be selectively provided based on a current operating mode of device 500. For example, various screen controls to control the video output provided on screen 508 may be provided on display 504 and/or on a portion of display 508.

Figure 13 illustrates a hand-held electronic device with multiple displays connected by a foldable coupling with the device configured as a recorder according to one embodiment of the present invention. The recording mode illustrated in Figure 13 provides representative functions for recording a video and/or audio input. Device 550 preferably includes a video output screen 552 connected by hinges 554 to a touch-sensitive input/output screen 556. Input/output screen 556 preferably includes various keys or buttons 558 and corresponding informational displays 560 associated with recording input signals received via an appropriate cable and/or wirelessly. Device 550 may include one or more physical buttons 562 which may have dedicated and/or programmable functions. Device 550 preferably includes one or more speakers 564 and a latch 566 with associated receiver 568 for keeping the device 550 in a closed and secured position when not in use.

Figure 14 illustrates a hand-held electronic device with multiple displays connected by a hinge with an optional external antenna for exchanging information according to one embodiment of the present invention. Device 600 includes a first display 602 connected to a second display 604 via one or more hinges 606. An optional external antenna 608 is provided for wirelessly receiving and/or transmitting information to another PDA, a base station, a computer, a wireless network, a satellite, a cellular network, or the like. Of course, depending upon the particular communication strategy utilized, an internal antenna may also be used without departing from the spirit or scope of the present invention.

Figure 15 provides a side view illustrating a portable hand-held electronic device for use as a PDA according to the present invention. Device 650 is illustrated in the folded or closed position. Device 650 preferably includes a variety of inputs/outputs which may be positioned in base portion 652 and/or cover portion 654. A port or slot 656 for receiving a computer-readable storage medium may be contained in base portion 652 or cover portion 654. Conventional computer-readable storage media including floppy disks, flash memory, CD-ROMs, and the like may be utilized with device 650. Slot or port 656 may be adapted to receive one or more modules to drive corresponding computer-readable storage media such as floppy disks and CD-ROMs.

Device 650 may include various other inputs such as nine-pin port 658 to exchange information with other devices. Of course, input/output ports having various other form factors and complying with various standards may also be provided. For example, a parallel port, a fire-wire port, a USB port, and the like may be provided. Preferably, device 650 includes stereo output jacks 660 which provide audio signals to appropriately sized speakers and/or headphones. In addition, a power jack 662 may be provided. Dial 664 may be used for a dedicated or programmable input function. For example, dial 664 may be used to control the volume, the screen contrast for one or more displays, and/or to cycle through menus displayed on the multiple displays of device 650.

Referring now to Figure 16, a block diagram illustrating operation of a system and/or method for exchanging data with a hand-held electronic device with

multiple displays according to the present invention is shown. System 700 may include a computer 702 which receives data from a download service 704 via a dedicated or dial-up connection 706. Download service 704 may be accessed by a dial-up connection using a modem, by a cable modem connection, DSL connection, satellite link, or the like. Computer 702 may be used to temporarily store digital information or may act simply as a conduit to pass digital information from download service 704 to portable hand-held digital device 708 which is connected to computer 702 via an appropriate link 710. Device 708 may connect to computer 702 using an appropriate cable connected to a serial port, parallel port, USB port, or the like. In addition, device 708 may connect to computer 702 using a wireless connection and transmit signals via infrared, radiowave, satellite, and the like.

System 700 may also transfer digital information to a computer-readable storage medium as represented by block 712. The computer-readable storage medium may include a CD-ROM, digital versatile disk (DVD), flash memory, and the like. The computer-readable storage medium is subsequently loaded into the hand-held device as illustrated and described above.

Alternatively, the PDA may connect directly to a download service 704 as represented by block 714. Similar to the connection to computer 702, the device connects directly to a server hosted by the download service using a cable connection through a serial port, parallel port, or the like. Alternatively, a wireless connection may be established using infrared, radiowave, satellite, etc.

As illustrated and described above using various representative embodiments, the present invention provides a PDA which may be selectively configurable in various operating modes to play/record video and/or audio, read/write e-mail, browse the Internet, and the like, or may contain only dedicated functions, such as a PDA, calculator, Internet browsing device, or the like. The use of multiple displays connected by a foldable coupling, such as a hinge, provides an acceptable form factor, while improving the display area and reducing the otherwise necessary screen manipulations including scrolling and paging. As such, the present invention provides a hand-held device which facilitates portable Internet access with increased functionality.

While embodiments of the invention have been illustrated and described, it is not intended that these embodiments illustrate and describe all possible forms of the invention. Rather, the words used in the specification are words of description rather than limitation, and it is understood that various changes
5 may be made without departing from the spirit and scope of the invention. One of ordinary skill in the art will recognize that the features or functions described in any given embodiment are adaptable to all embodiments shown and other embodiments within the scope of the invention.

WHAT IS CLAIMED IS:

1 1. A hand-held portable electronic device capable of being used as
2 a personal digital assistant, the hand-held device comprising:
3 a housing having a first display, a processor, and a memory, the
4 processor being in communication with the first display and the memory;
5 a cover connected to the housing by a foldable coupling, the cover
6 including a second display in communication with the processor, wherein the
7 processor generates output signals to display information on at least one of the first
8 and second displays;
9 input means in communication with the processor for selectively
10 controlling functionality of the device; and
11 means for establishing an electrical connection between the processor,
12 the input means, and the first and second displays.

1 2. The portable electronic device of claim 1 wherein at least one of
2 the first and second displays is selectively configurable by the processor to function
3 as a touch-sensitive input device.

1 3. The portable electronic device of claim 1 wherein at least one of
2 the first and second displays includes a first portion for displaying information to the
3 user and a second portion for receiving input from the user.

1 4. The portable electronic device of claim 1 wherein the foldable
2 coupling comprises at least one hinge connecting the cover to the housing.

1 5. The portable electronic device of claim 1 wherein at least one of
2 the first and second displays comprises an LCD screen.

1 6. The portable electronic device of claim 1 wherein at least one of
2 the first and second displays comprises an active matrix display.

1 7. The portable electronic device of claim 1 wherein the input means
2 comprises a plurality of buttons positioned within the housing or the cover and in

3 communication with the processor for controlling information displayed on at least
4 one of the first and second displays.

1 8. The portable electronic device of claim 1 wherein the housing
2 includes a transceiver in communication with the processor for wirelessly
3 transmitting and receiving data.

1 9. The portable electronic device of claim 1 wherein the processor
2 is operative to display images depicting a numeric keypad on at least one of the first
3 and second displays.

1 10. The portable electronic device of claim 1 wherein the processor
2 is operative to display images depicting an alphanumeric keypad on at least one of
3 the first and second displays.

1 11. The portable electronic device of claim 1 wherein the processor
2 is operative to provide Internet access functions.

1 12. The portable electronic device of claim 1 wherein at least one of
2 the first and second displays is configured to provide an Internet viewing area.

1 13. The portable electronic device of claim 1 wherein at least one of
2 the first and second displays includes at least a portion configured to provide an
3 Internet access input means.

1 14. The portable electronic device of claim 1 wherein one of the first
2 and second displays includes a first portion for displaying information to the user
3 while another of the first and second displays includes a second portion for
4 generating signals based on user input.

1 15. The portable electronic device of claim 1 wherein the processor
2 is operative to display text or images on the first and second displays such that the
3 first and second displays function as a single display.

1 16. The portable electronic device of claim 1 wherein the processor
2 is operative to scroll text between a bottom portion of the second display and a top
3 portion of the first display.

1 17. The portable electronic device of claim 1 wherein the housing
2 includes a port for receiving a computer readable storage medium containing data
3 and/or instructions useable by the processor to selectively reconfigure at least one
4 of the first and second displays.

1 18. The portable electronic device of claim 1 further comprising a
2 removable computer readable storage medium containing configuration data and/or
3 instructions useable by the processor to selectively reconfigure at least one of the
4 first and second displays.

1 19. The portable electronic device of claim 1 wherein the housing
2 includes at least one connector for selectively receiving a cable to exchange data with
3 a computer.

1 20. The portable electronic device of claim 1 wherein the housing or
2 the cover includes a plurality of cursor control keys in communication with the
3 processor for providing directional signals in response to a user's touch.

1 21. The portable electronic device of claim 1 wherein the processor
2 is operative to selectively configure the first and second displays for horizontal or
3 vertical viewing in response to a corresponding command received from the user.

1 22. A portable wireless electronic device comprising:
2 a housing including a base portion and a cover portion connected to
3 the base portion by at least one hinge;
4 a transceiver disposed within the housing and in communication with
5 an antenna for selectively receiving transmitted signals and selectively transmitting
6 signals;
7 a first display disposed within the base portion of the housing;
8 a second display disposed within the cover portion of the housing;

9 a processor disposed within the housing and in communication with
10 the transceiver, the first display, and the second display, the processor including
11 memory having stored data representing instructions for configuring the first display
12 to selectively display keys for receiving commands from a user, and for configuring
13 the second display to selectively display information based on commands received
14 from the keypad and/or information received from the transceiver, wherein at least
15 a portion of the first display is selectively reconfigured by the processor to display
16 information received from the transceiver such that the portion of the first display
17 and the second display operate as a single continuous display.

1 23. The portable wireless electronic device of claim 22 wherein the
2 first and second displays comprise first and second regions of a flexible monolithic
3 screen.

1 24. The portable wireless electronic device of claim 22 wherein at
2 least one of the first and second displays comprises an LCD screen.

1 25. The portable wireless electronic device of claim 22 wherein the
2 housing includes a plurality of keys for entry of user data or commands.

1 26. The portable wireless electronic device of claim 22 wherein at
2 least one of the first and second displays comprises an active matrix display.

1 27. The portable wireless electronic device of claim 22 wherein the
2 processor is operative to scroll text between a bottom portion of the second display
3 and a top portion of the first display.

1 28. The portable wireless electronic device of claim 22 further
2 comprising a disk drive disposed within the housing and in communication with the
3 processor to selectively store and retrieve data.

1 29. The portable wireless electronic device of claim 22 wherein the
2 processor is operative to display images depicting a numeric keypad on at least one
3 of the first and second displays.

1 30. The portable wireless electronic device of claim 22 wherein the
2 processor is operative to display images depicting an alphanumeric keypad on at least
3 one of the first and second displays.

1 31. The portable wireless electronic device of claim 22 wherein the
2 processor is operative to access the Internet.

1 32. The portable wireless electronic device of claim 22 wherein at
2 least one of the first and second displays provides an Internet viewing area.

1 33. The portable wireless electronic device of claim 22 wherein at
2 least one of the first and second displays includes at least a portion for providing
3 input means to access the Internet.

1 34. A hand-held electronic organizer for use as a personal digital
2 assistant, the hand-held electronic organizer comprising:

3 a housing having a first display, a processor, and a memory, the
4 processor being in communication with the first display and the memory;

5 a cover connected to the housing by a plurality of hinges, the cover
6 including a second display in communication with the processor via an electrical
7 connector hidden within at least one of the plurality of hinges, wherein the processor
8 generates output signals to display information on at least one of the first and second
9 displays based at least in part on input received from a user.

1 35. The hand-held electronic organizer of claim 34 wherein at least
2 one of the first and second displays is selectively configurable by the processor to
3 display information corresponding to functions which may be activated by the user
4 touching the display.

1 36. The hand-held electronic organizer of claim 34 wherein at least
2 one of the first and second displays includes a physical overlay defining a first
3 portion for displaying information to the user and a second portion for receiving
4 input from the user.

1 37. The hand-held electronic organizer of claim 34 wherein at least
2 one of the first and second displays comprises an LCD screen.

1 38. The hand-held electronic organizer of claim 34 wherein at least
2 one of the first and second displays comprises an active matrix display.

1 39. The hand-held electronic organizer of claim 34 further
2 comprising:

3 a plurality of buttons positioned within the housing or the cover and
4 in communication with the processor for controlling functioning of the electronic
5 organizer.

1 40. The hand-held electronic organizer of claim 39 wherein the
2 housing includes a transceiver in communication with the processor for wirelessly
3 transmitting and receiving data.

1 41. The hand-held electronic organizer of claim 40 wherein the
2 processor is operative to display images depicting a numeric keypad on at least one
3 of the first and second displays.

1 42. The hand-held electronic organizer of claim 40 wherein the
2 processor is operative to display images depicting an alphanumeric keypad on at least
3 one of the first and second displays.

1 43. The hand-held electronic organizer of claim 40 wherein the
2 processor is operative to provide Internet access functions.

1 44. The hand-held electronic organizer of claim 40 wherein at least
2 one of the first and second displays is operative to provide an Internet viewing area.

1 45. The hand-held electronic organizer of claim 40 wherein at least
2 one of the first and second displays includes at least a portion which functions as an
3 Internet access input means.

1 46. The hand-held electronic organizer of claim 34 wherein the
2 processor is operative to display text or images on the first and second displays such
3 that the first and second displays function as a single display to reduce the frequency
4 of scrolling and/or paging when viewing electronic data.

1 47. The hand-held electronic organizer of claim 42 wherein the
2 processor is operative to scroll text between a bottom portion of the second display
3 and a top portion of the first display.

1 48. The hand-held electronic organizer of claim 47 wherein the
2 housing includes a port for receiving a computer readable storage medium containing
3 data and/or instructions useable by the processor to selectively reconfigure at least
4 one of the first and second displays.

1 49. The hand-held electronic organizer of claim 47 further
2 comprising a removable computer readable storage medium containing configuration
3 data and/or instructions useable by the processor to selectively reconfigure at least
4 one of the first and second displays.

1 50. The hand-held electronic organizer of claim 49 wherein the
2 housing includes at least one connector for selectively receiving a cable to exchange
3 data with a computer.

1 51. The hand-held electronic organizer of claim 34 wherein the
2 housing or the cover includes a plurality of cursor control keys in communication
3 with the processor for providing directional signals in response to a user's touch.

1 52. The hand-held electronic organizer of claim 51 wherein the
2 processor is operative to selectively configure the first and second displays for

3 horizontal or vertical viewing in response to a corresponding command received
4 from the user.

1 53. A portable hand-held electronic device for use as a personal
2 digital assistant, the device comprising:

3 a housing having a base portion and a cover portion connected by a
4 foldable coupling;

5 a plurality of electronic displays with at least one of the plurality of
6 electronic displays disposed within the base portion of the housing and at least one
7 of the plurality of electronic displays disposed within the cover portion of the
8 housing;

9 a processor disposed within the housing and in communication with
10 the plurality of displays, the processor generating signals to selectively configure the
11 plurality of displays as input and/or output devices for receiving information from
12 a user and displaying information to a user, respectively,;

13 a transceiver disposed within the housing and in communication with
14 the processor, the transceiver for selectively wirelessly transmitting and receiving
15 digital information;

16 at least one communication port disposed within the housing and in
17 communication with the processor for exchanging information with a computer;

18 a plurality of buttons located in the housing and in communication
19 with the processor, the plurality of buttons in communication with the processor and
20 selectively configurable by the processor to control at least one of the plurality of
21 displays and/or functioning of the device; and

22 a removable computer readable storage medium engageable with the
23 housing to be in selective communication with the processor, the computer readable
24 storage medium including stored data representing instructions executable by the
25 processor to selectively configure the device.

1 54. The portable hand-held electronic device of claim 53 wherein the
2 processor is operative to selectively configure the plurality of displays for horizontal
3 or vertical viewing in response to a corresponding command received from the user.

1 55. The portable hand-held electronic device of claim 53 wherein the
2 processor selectively configures at least two of the plurality of displays to function
3 as a single display.

1 56. The portable hand-held electronic device of claim 55 wherein the
2 processor selectively configures the at least two displays to scroll text between
3 adjacent displays.

1 57. The portable hand-held electronic device of claim 53 wherein the
2 foldable coupling comprises at least one hinge.

1 58. The portable hand-held electronic device of claim 53 further
2 comprising foldable electrical connecting means for connecting at least one of the
3 plurality of displays to the processor through the foldable coupling between the base
4 portion and the cover portion.

1 59. The portable hand-held electronic device of claim 53 wherein at
2 least one of the plurality of displays comprises an LCD screen.

1 60. The portable hand-held electronic device of claim 53 wherein at
2 least one of the plurality of displays comprises:
3 a first portion for displaying touch activated buttons;
4 a second portion separated from the first portion by a physical
5 overlay, the second portion being configured to function as a cursor control touch
6 pad.

1 61. The portable hand-held electronic device of claim 53 wherein the
2 processor is operative to display a numeric keypad on at least one of the plurality of
3 displays.

1 62. The portable hand-held electronic device of claim 53 wherein the
2 processor is operative to display an alphanumeric keypad on at least one of the
3 plurality of displays.

1 63. The portable hand-held electronic device of claim 53 wherein the
2 processor is operative to provide Internet access functions.

1 64. The portable hand-held electronic device of claim 53 wherein at
2 least one of the plurality of displays functions as an Internet viewing area.

1 65. The portable hand-held electronic device of claim 53 wherein at
2 least one of the plurality of displays includes at least a portion which functions as an
3 Internet access input means.

1 66. A hand-held portable electronic device capable of being used as
2 a personal digital assistant, the hand-held device comprising:
3 a housing having a first display, a processor, and a memory, the
4 processor being in communication with the first display and the memory;
5 a cover connected to the housing by a foldable coupling, the cover
6 including a second display in communication with the processor, wherein the
7 processor generates output signals to display information on at least one of the first
8 and second displays;
9 input means in communication with the processor for selectively
10 controlling functionality of the device;
11 means for establishing an electrical connection between the processor,
12 the input means, and the first and second displays; and
13 wherein the processor is operative to provide Internet browsing
14 functions.

1 67. The portable electronic device of claim 66 wherein at least one
2 of the first and second displays is configured to provide an Internet viewing area.

1 68. The portable electronic device of claim 67 wherein at least one
2 of the first and second displays includes at least a portion configured to provide an
3 Internet access input means.

1 69. The portable electronic device of claim 68 wherein at least one
2 of the first and second displays is selectively configurable by the processor to
3 function as a touch-sensitive input device.

1 70. The portable electronic device of claim 68 wherein at least one
2 of the first and second displays includes a first portion for displaying information to
3 the user and a second portion for receiving input from the user.

1 71. The portable electronic device of claim 68 wherein the foldable
2 coupling comprises at least one hinge connecting the cover to the housing.

1 72. The portable electronic device of claim 68 wherein at least one
2 of the first and second displays comprises an LCD screen.

1 73. The portable electronic device of claim 68 wherein at least one
2 of the first and second displays comprises an active matrix display.

1 74. The portable electronic device of claim 68 wherein the input
2 means comprises a plurality of buttons positioned on the housing or the cover and
3 in communication with the processor for controlling information displayed on at least
4 one of the first and second displays.

1 75. The portable electronic device of claim 68 wherein the housing
2 includes a transceiver in communication with the processor for wirelessly
3 transmitting and receiving data.

1 76. The portable electronic device of claim 68 wherein the processor
2 is operative to display images depicting a numeric keypad on at least one of the first
3 and second displays.

1 77. The portable electronic device of claim 68 wherein the processor
2 is operative to display images depicting an alphanumeric keypad on at least one of
3 the first and second displays.

1 78. The portable electronic device of claim 68 wherein at least one
2 of the first and second displays is configured to provide an Internet viewing area.

1 79. The portable electronic device of claim 68 wherein at least one
2 of the first and second displays includes at least a portion configured to provide an
3 Internet access input means.

1 80. The portable electronic device of claim 68 wherein one of the
2 first and second displays includes a first portion for displaying information to the
3 user while another of the first and second displays includes a second portion for
4 generating signals based on user input.

1 81. The portable electronic device of claim 68 wherein the processor
2 is operative to display text or images on the first and second displays such that the
3 first and second displays function as a single display.

1 82. The portable electronic device of claim 68 wherein the processor
2 is operative to scroll text between a bottom portion of the second display and a top
3 portion of the first display.

1 83. The portable electronic device of claim 68 wherein the housing
2 includes a port for receiving a computer readable storage medium containing data
3 and/or instructions useable by the processor to selectively reconfigure at least one
4 of the first and second displays.

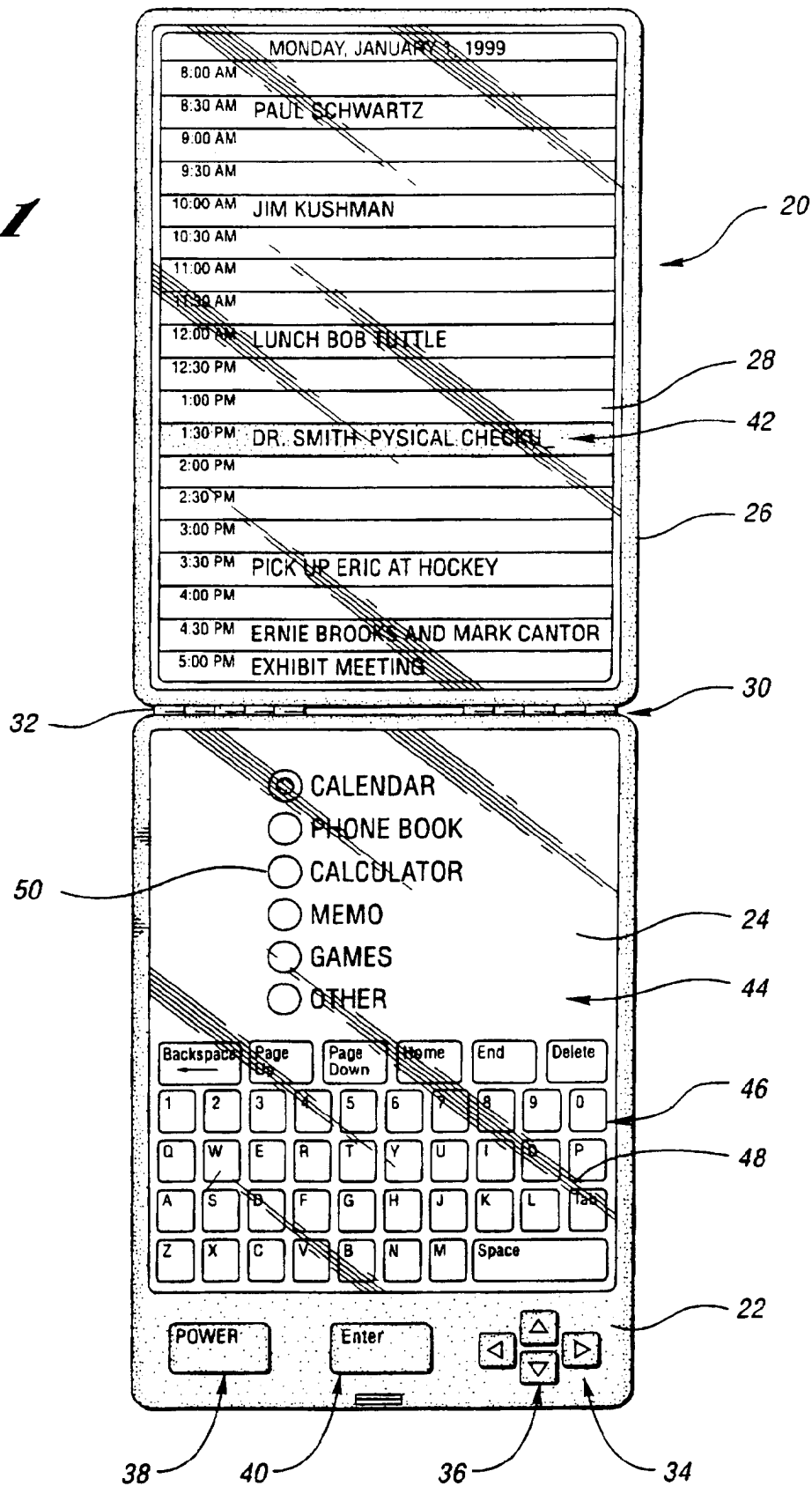
1 84. The portable electronic device of claim 68 further comprising a
2 removable computer readable storage medium containing configuration data and/or
3 instructions useable by the processor to selectively reconfigure at least one of the
4 first and second displays.

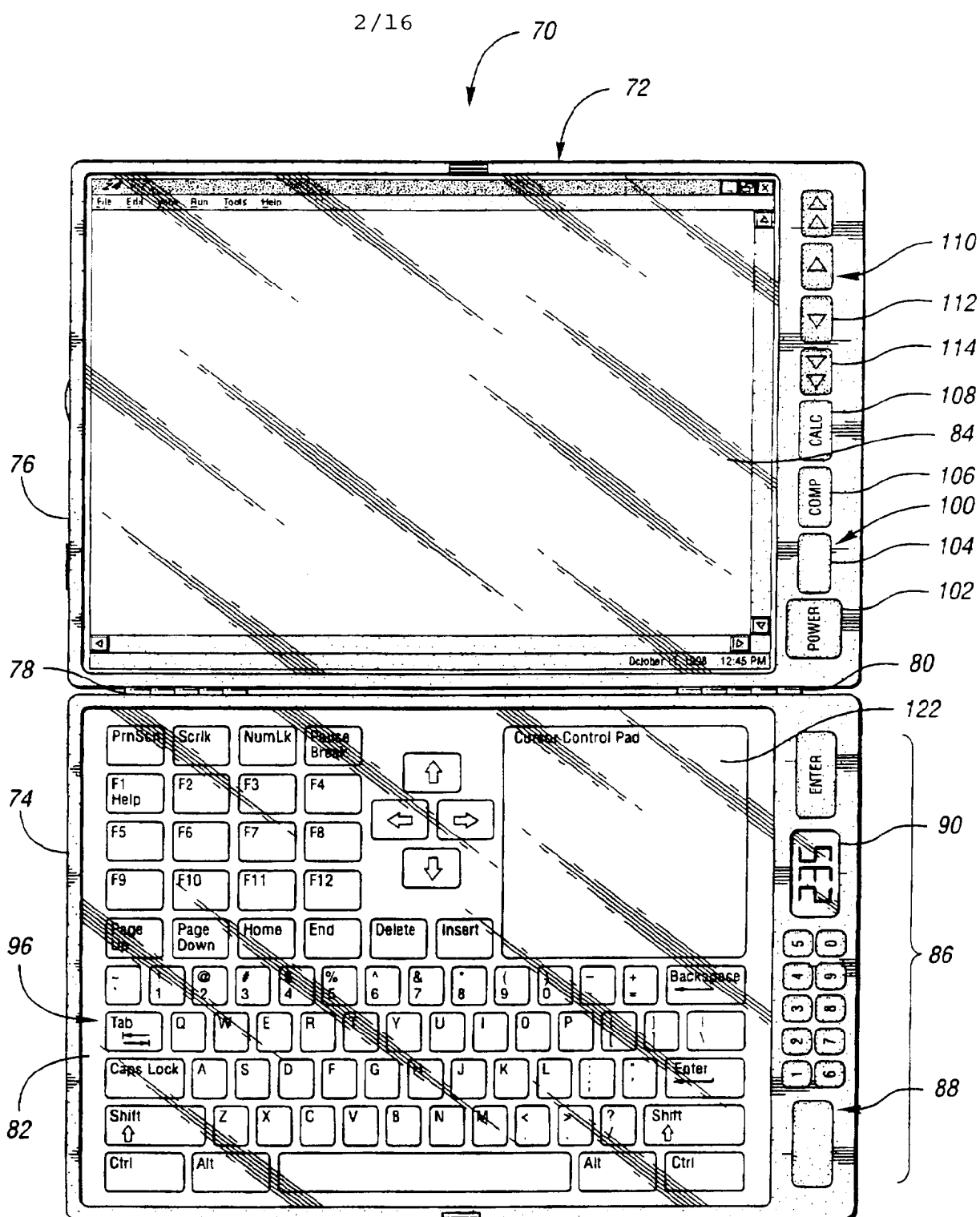
1 85. The portable electronic device of claim 68 wherein the housing
2 includes at least one connector for selectively receiving a cable to exchange data with
3 a computer.

1 86. The portable electronic device of claim 68 wherein the housing
2 or the cover includes a plurality of cursor control keys in communication with the
3 processor for providing directional signals in response to a user's touch.

1 87. The portable electronic device of claim 68 wherein the processor
2 is operative to selectively configure the first and second displays for horizontal or
3 vertical viewing in response to a corresponding command received from the user.

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Fig. 1

*Fig. 2*

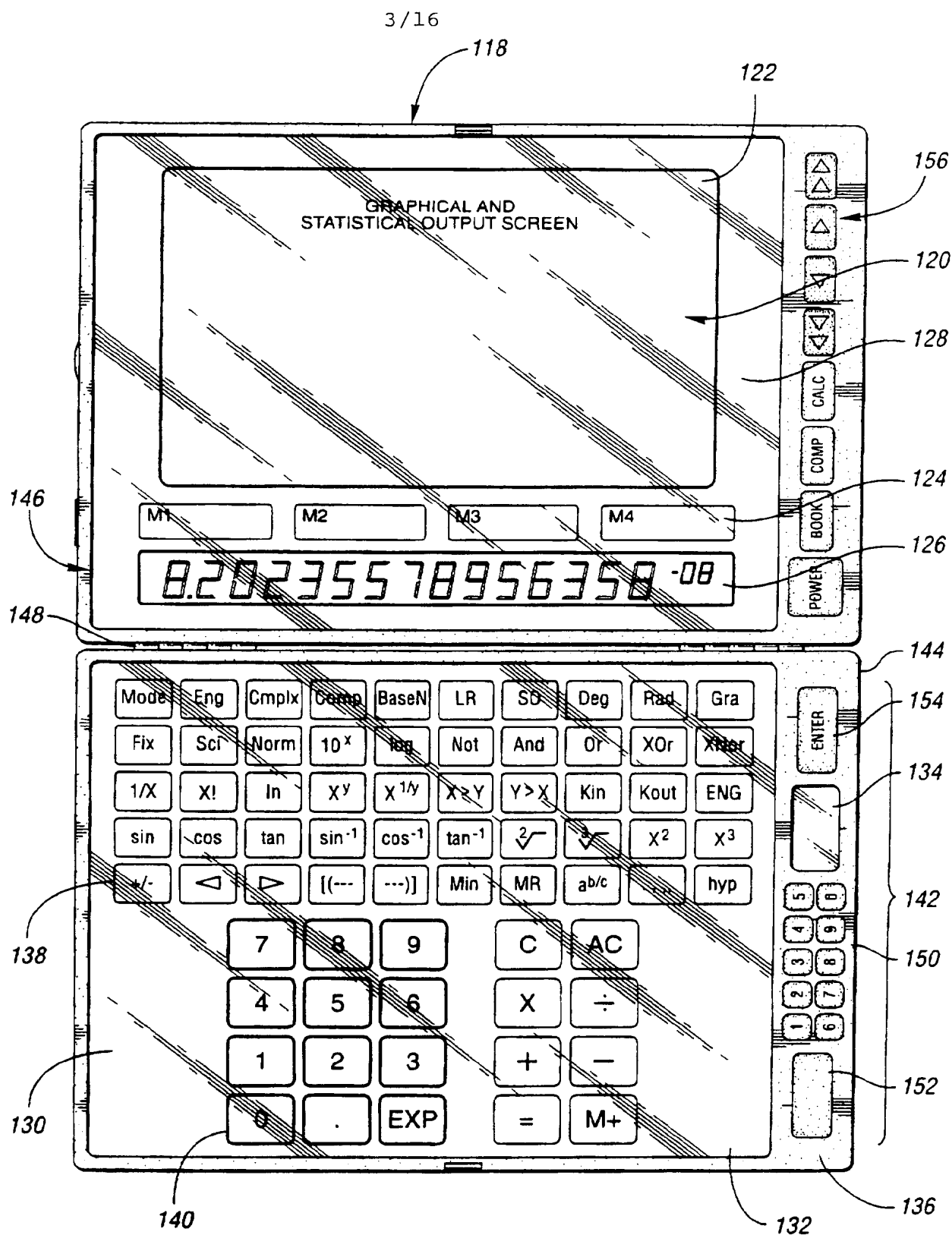
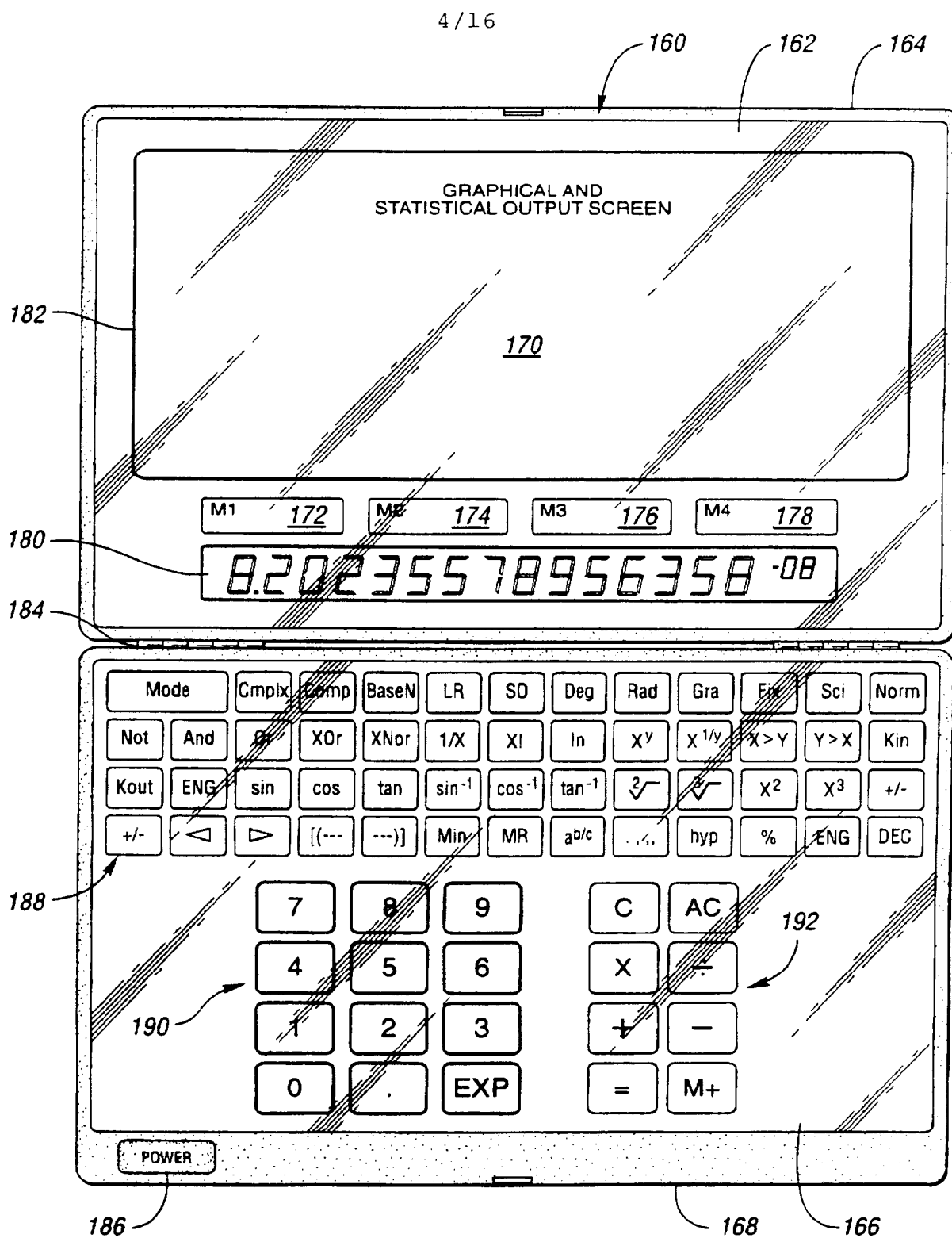
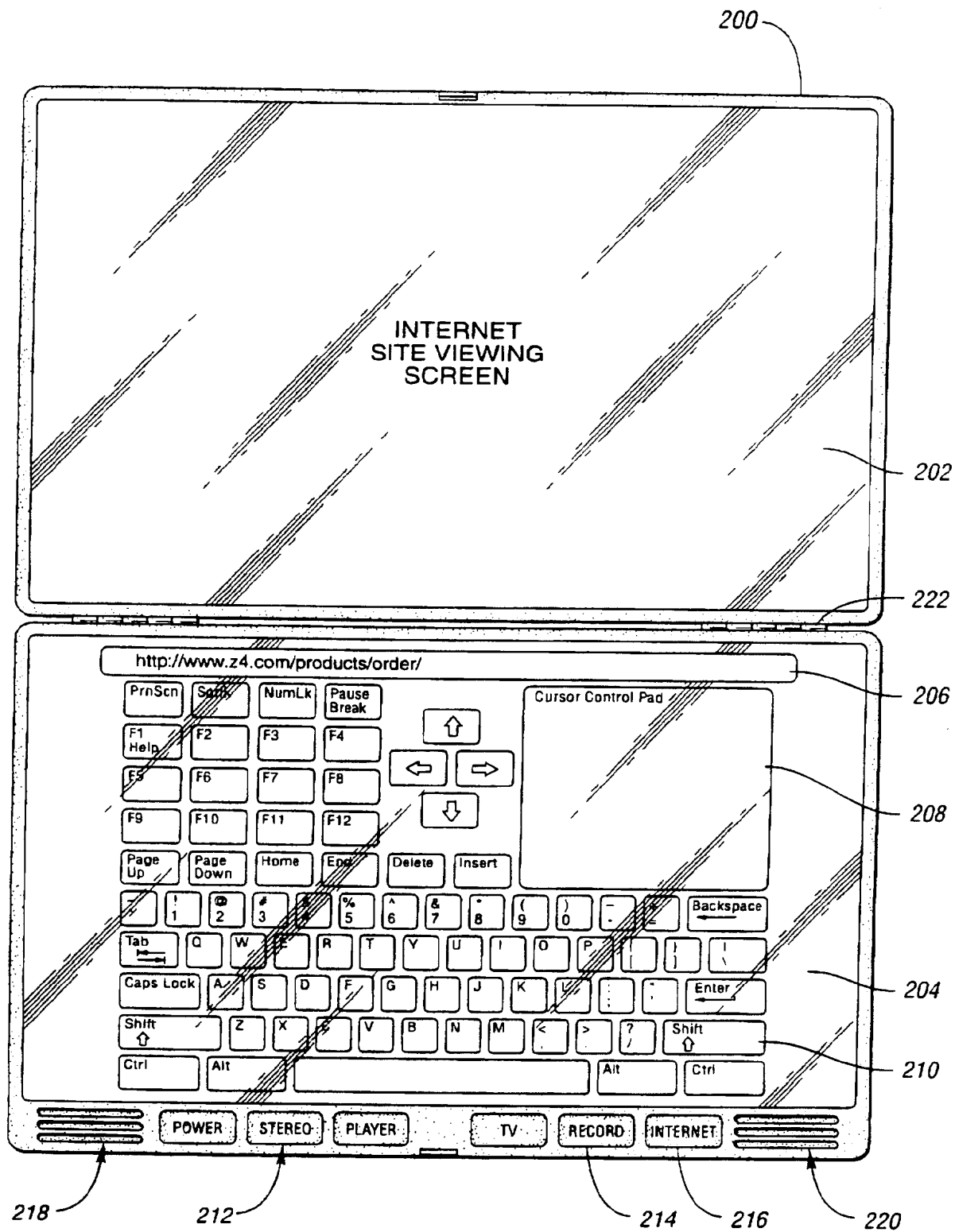


Fig. 3

*Fig. 4*

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*Fig. 5*

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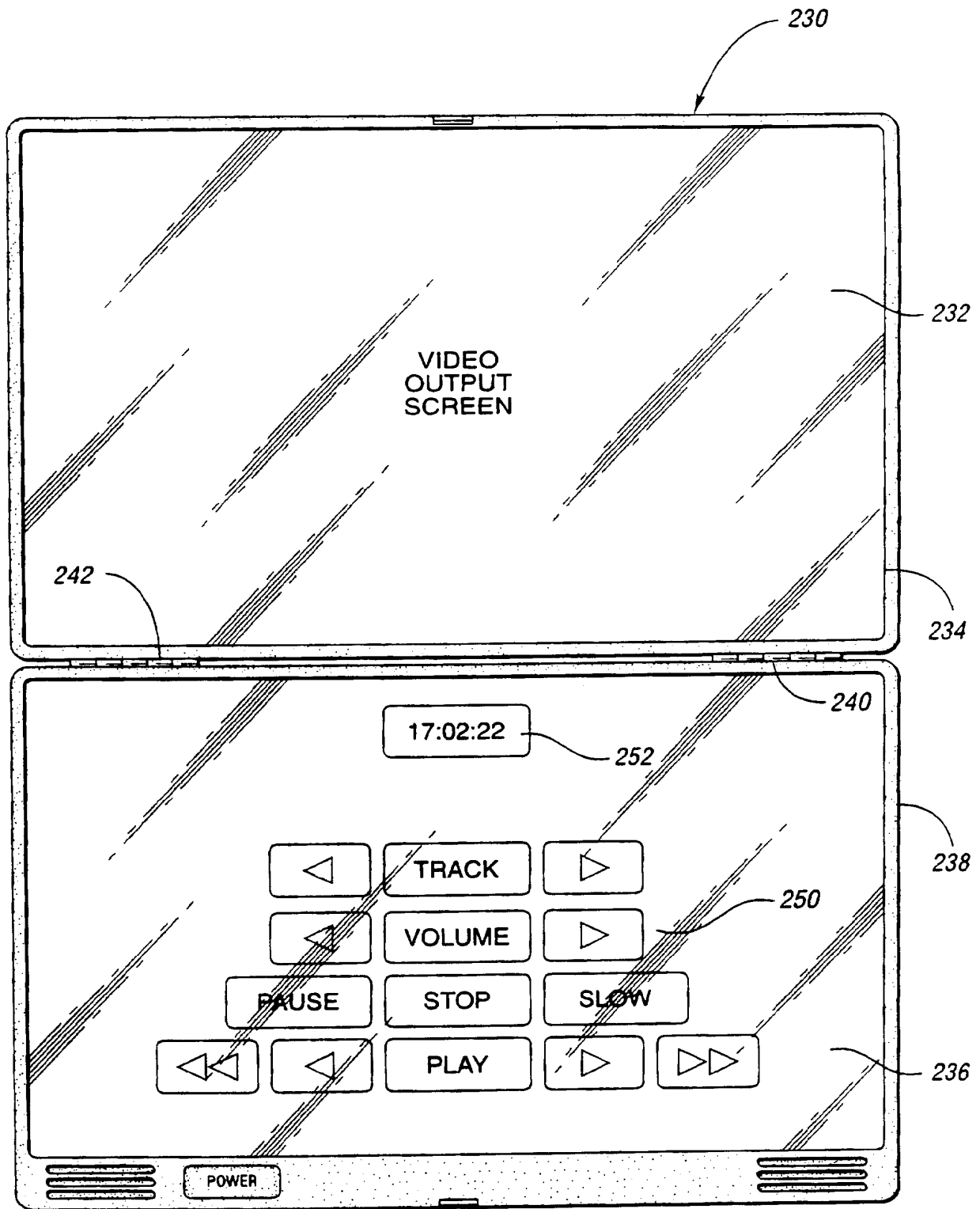
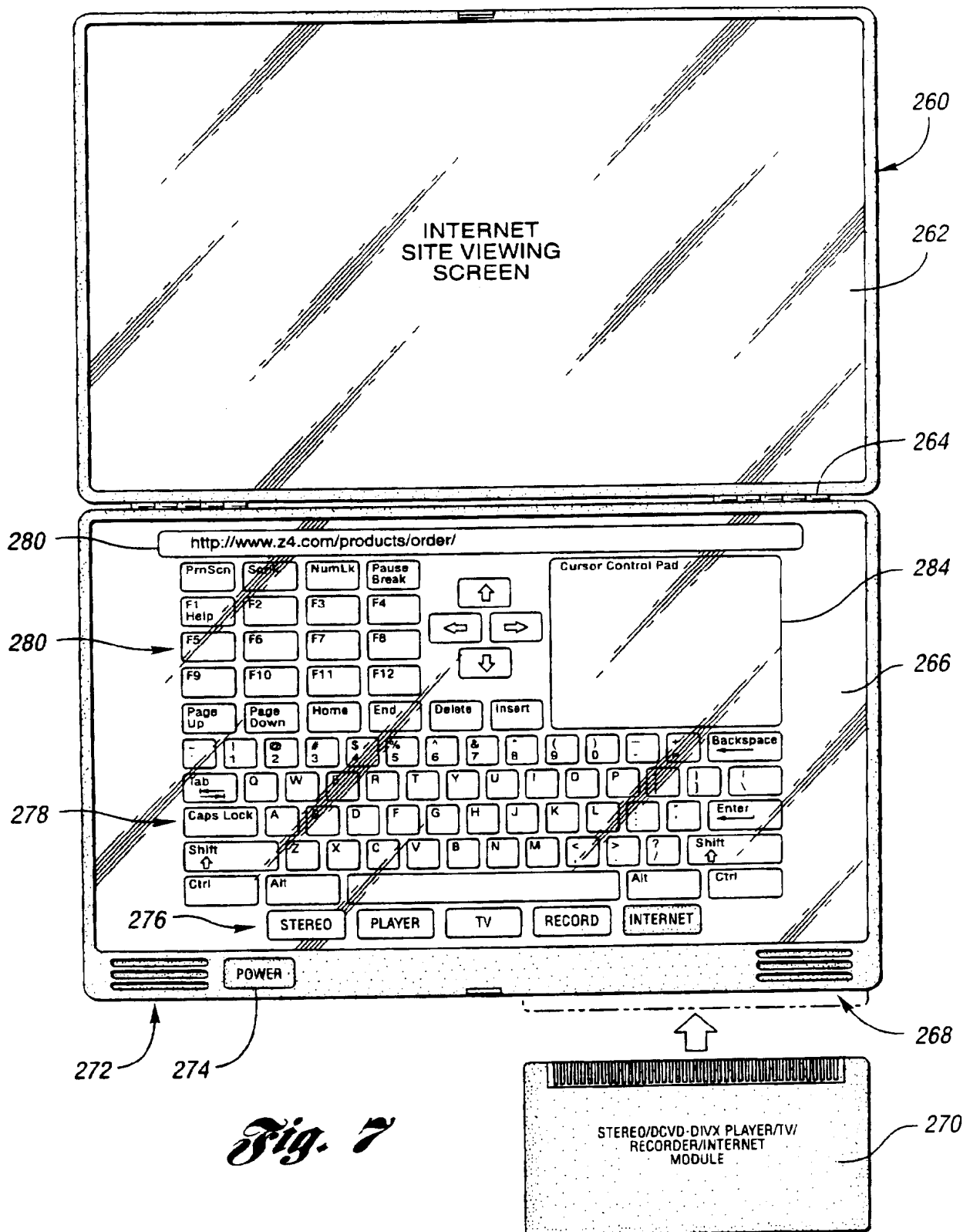
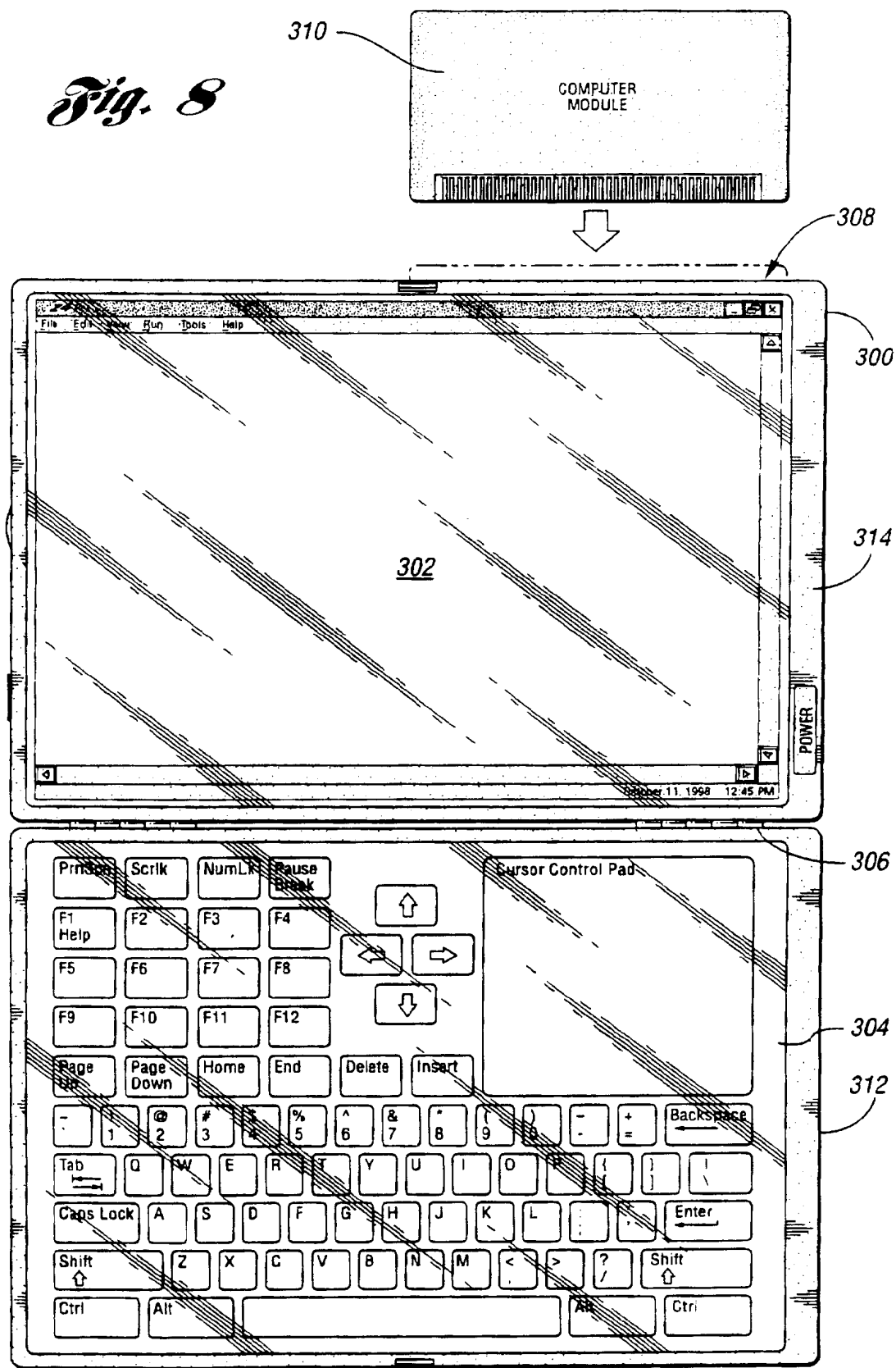


Fig. 6

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Fig. 8

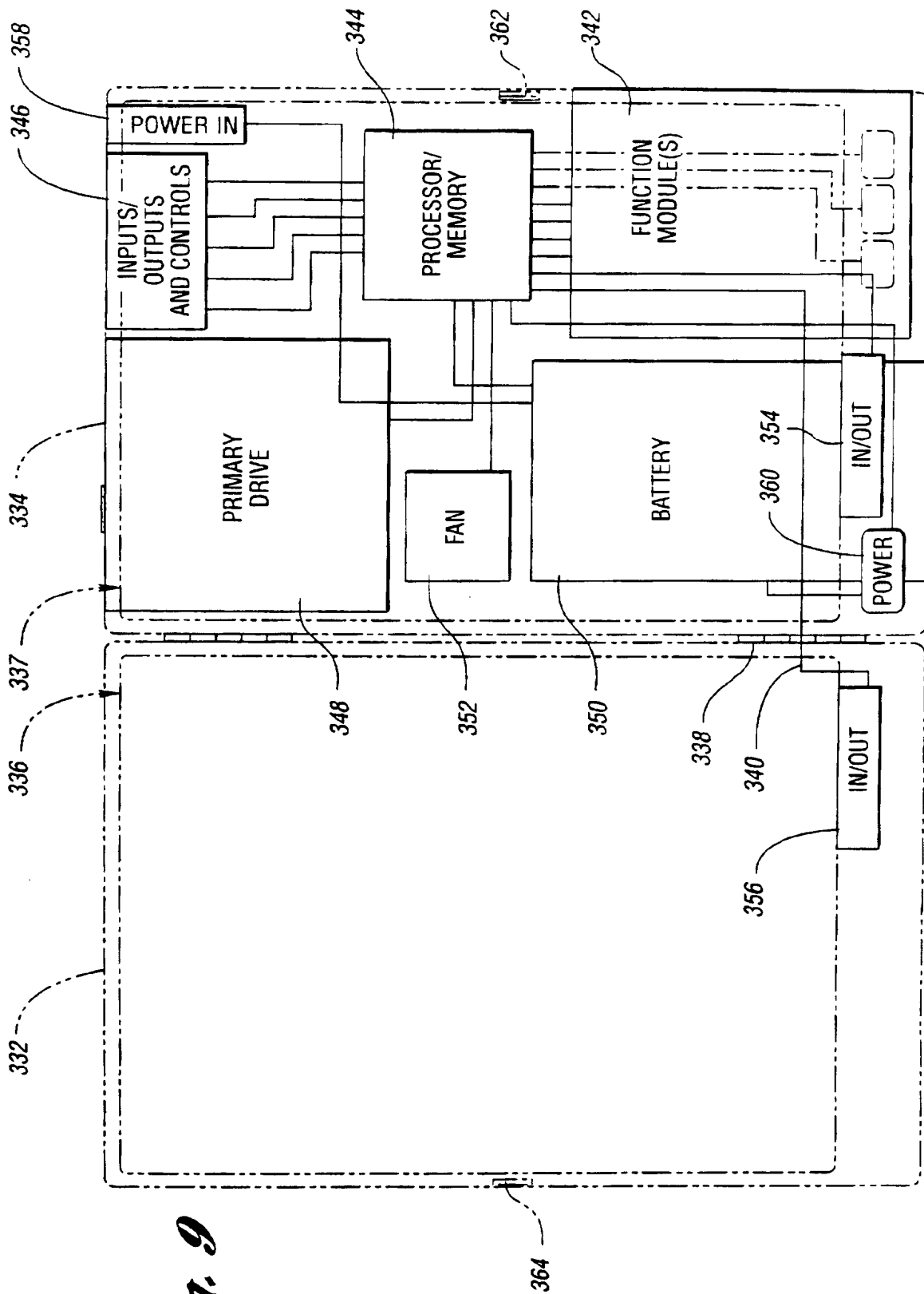


Fig. 9

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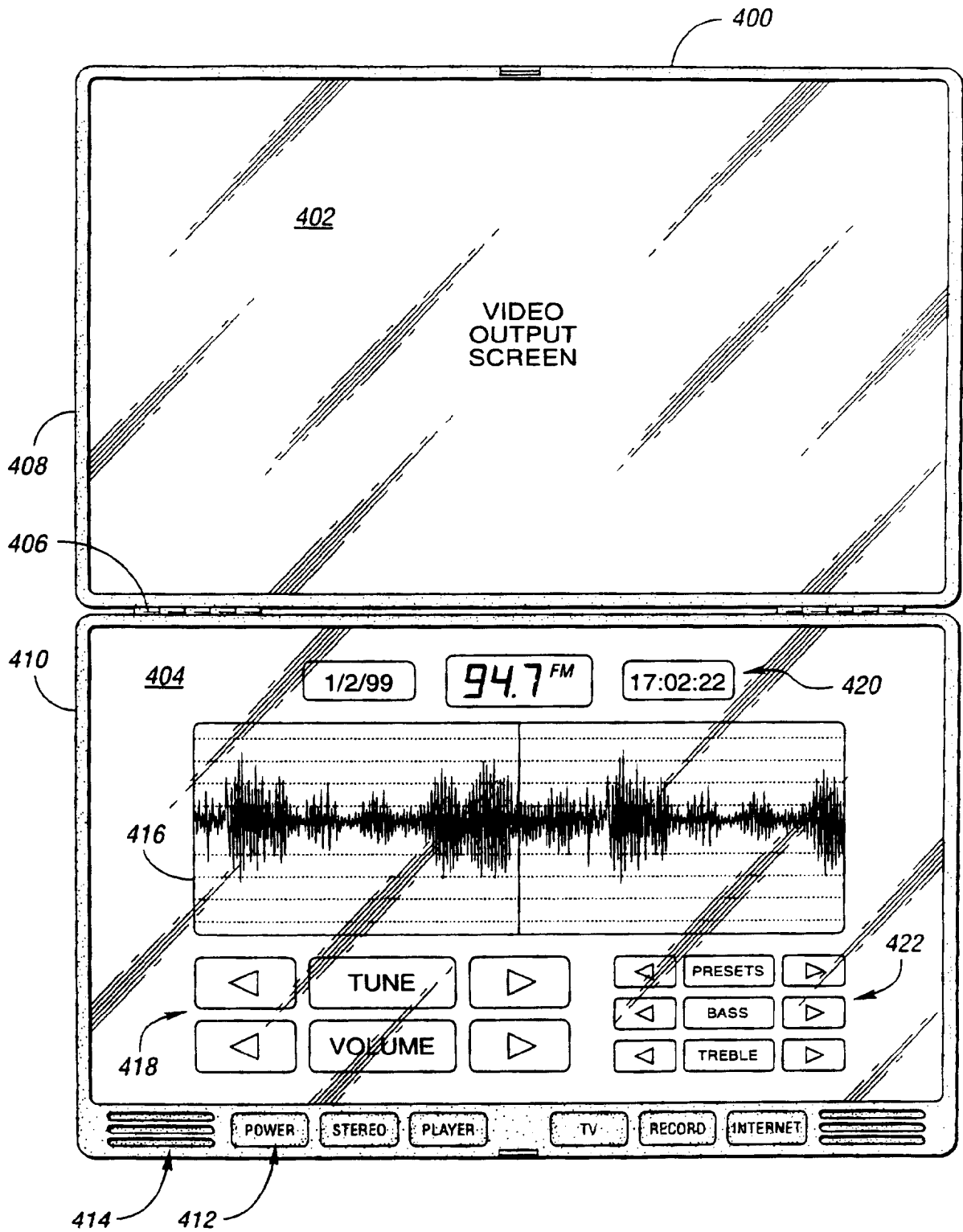


Fig. 10

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450

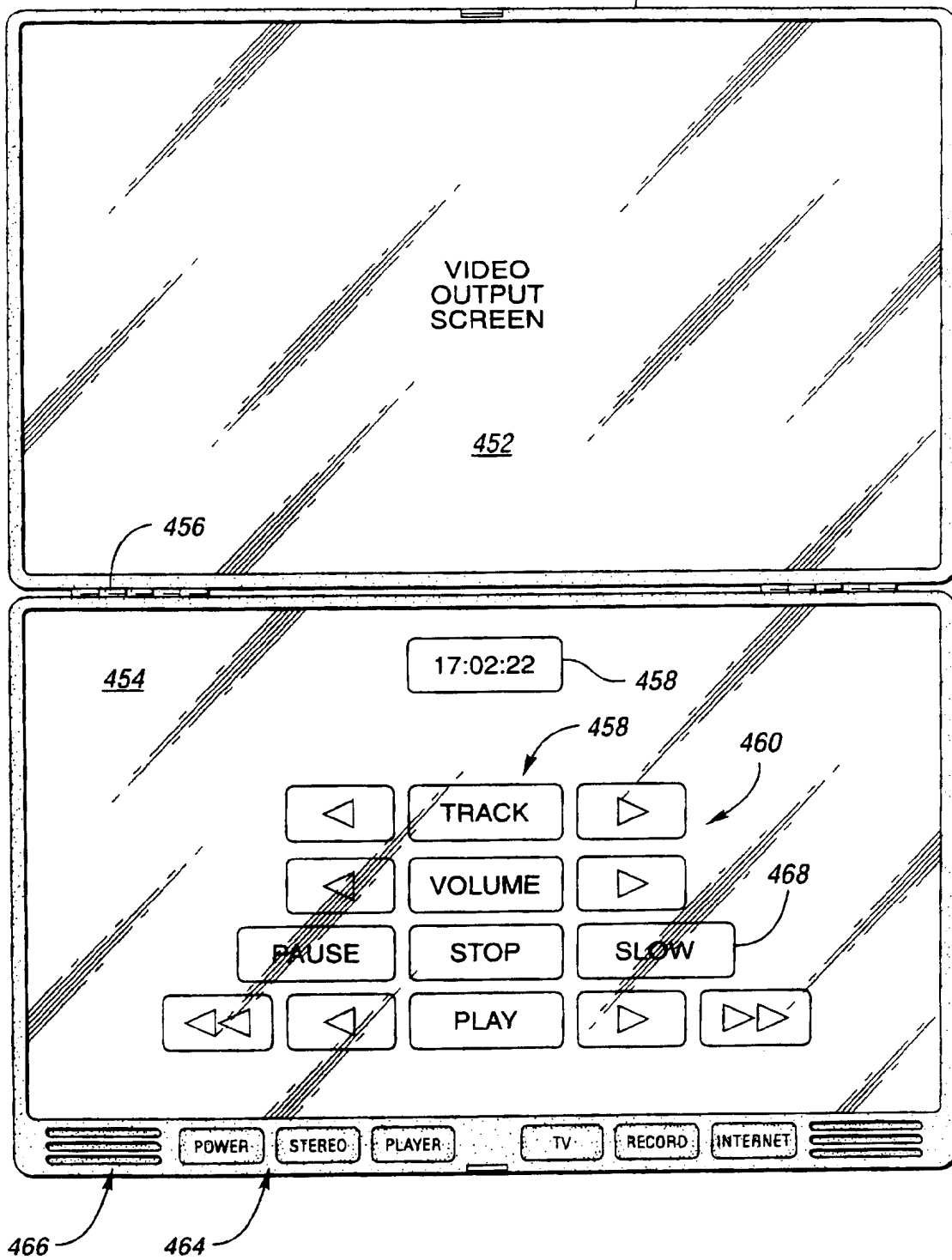
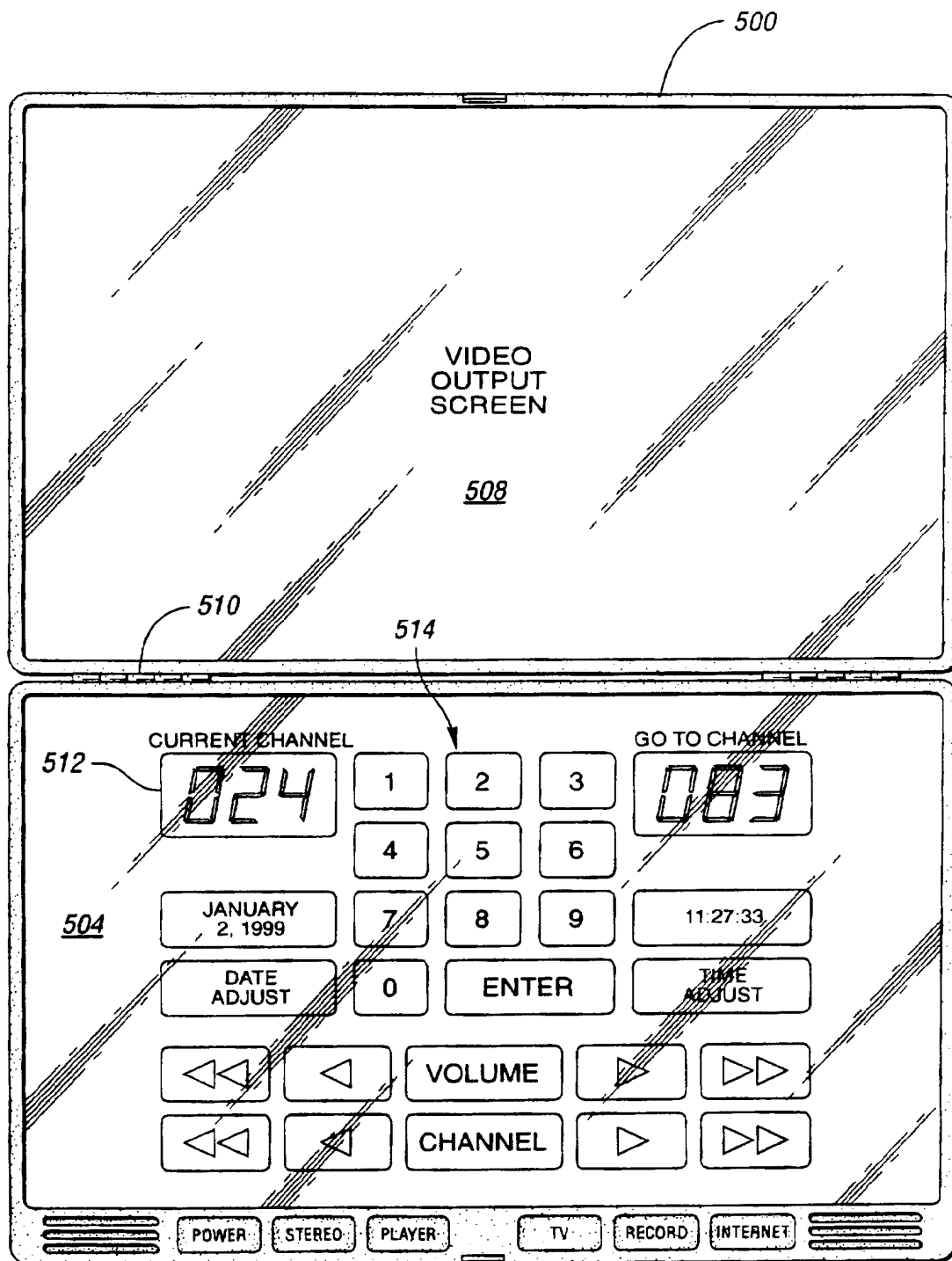


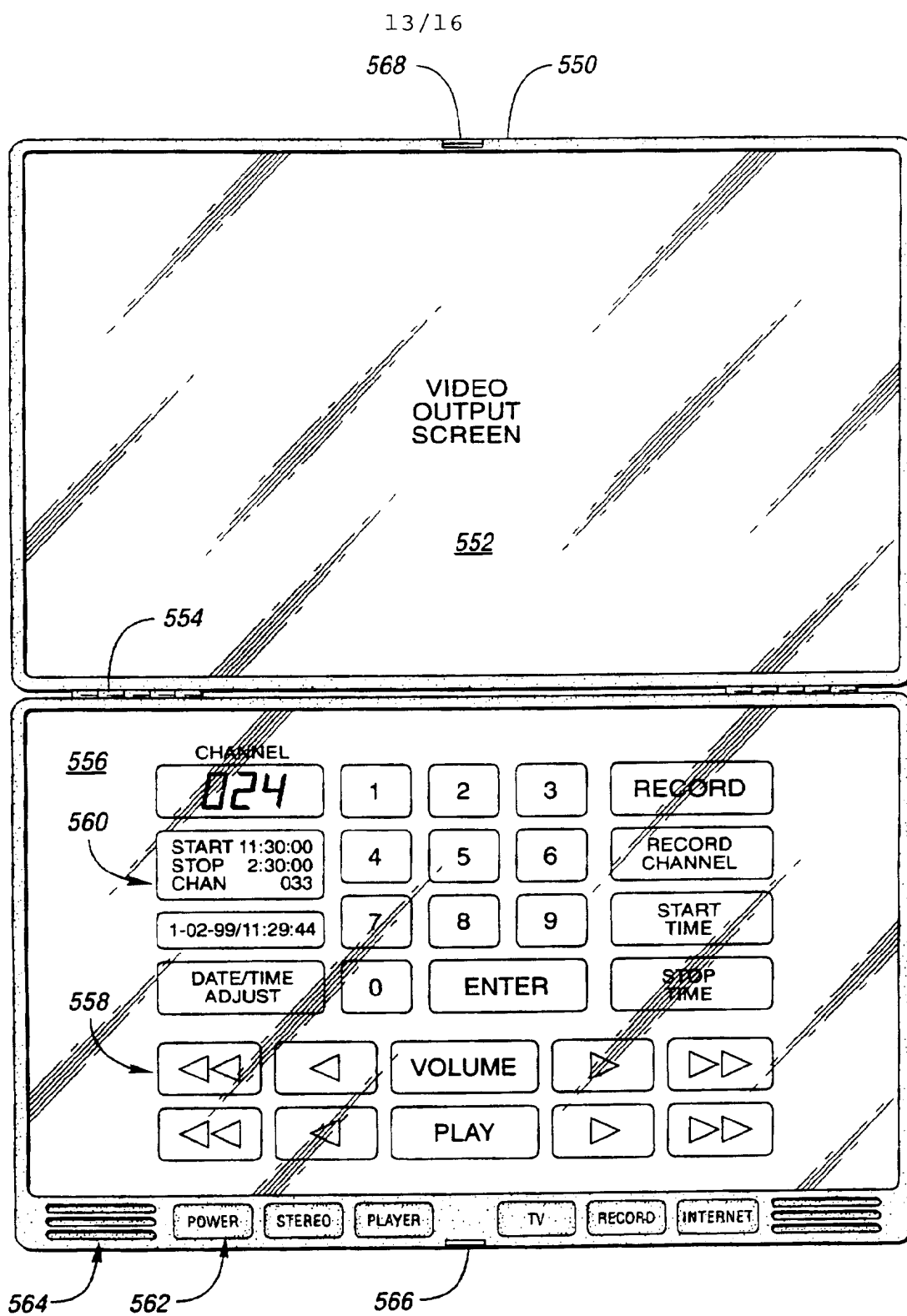
Fig. 11

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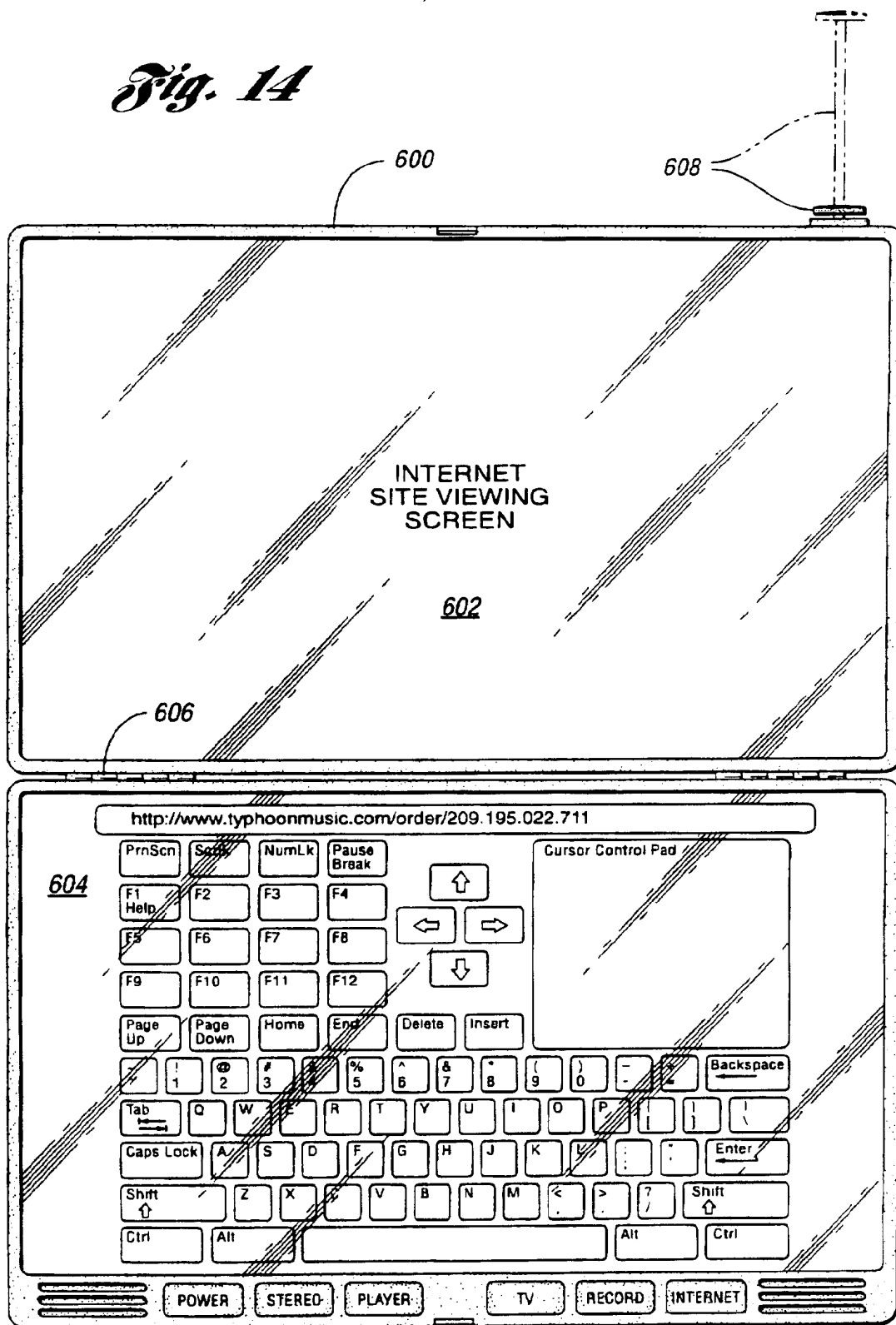


502

Fig. 12

*Fig. 13*

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Fig. 14

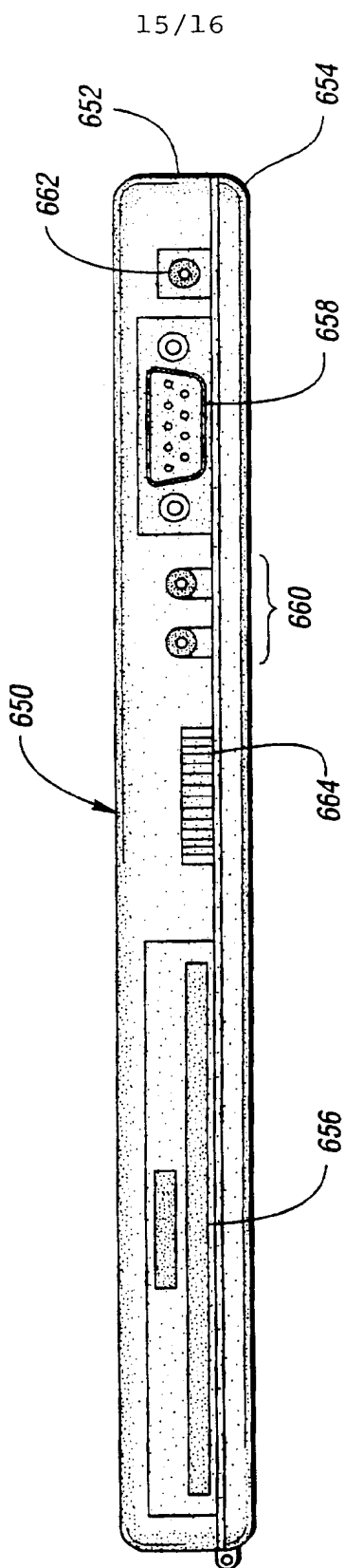
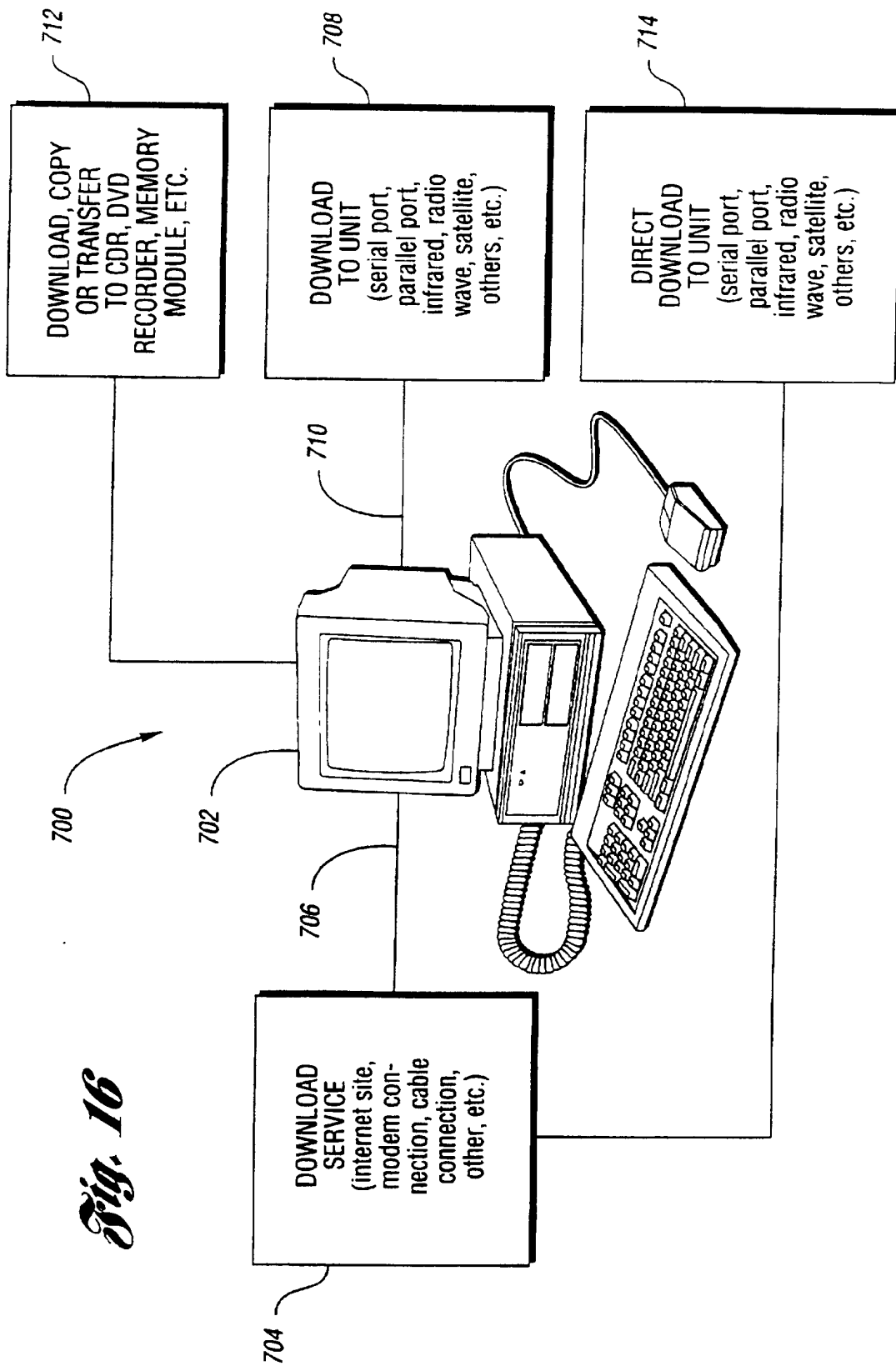


Fig. 15

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US00/40264

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G06F 3/00; G09G 5/00

US CL : 345/156, 173, 340, 901, 905; 178/18, 19; 395/800; 364/708.1

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 345/156, 173, 340, 901, 905; 178/18, 19; 395/800; 364/708.1

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Microsoft Press-Computer Dictionary-Third Edition 1997

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Examiner Automatic Search Tools (EAST)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,847,698 A (REAVEY et al) 08 December 1998 (08.12.1998), column 1, lines 5-15, line 41, column 2, lines 1-2, lines 5-6, lines 13-23, lines 45-48, lines 57-60, col. 3, lines 1-33, lines 48-57, col. 4, lines 4-8, col. 5, lines 17-19, lines 32-67, col. 6, lines 1-32, col. 7, lines 9-23, col. 8, lines 25-28, figures 2-7	1-18, 20-49, 51-52, 66-84, 86-87
Y	US 5,467,102 A (KUNO et al) 14 November 1995 (14.11.1995), column 9, lines 7-10, lines 29-34, and Figure 11.	19, 50, 53-65, 85
Y		19, 50, 53-65, 85

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search

13 September 2000 (13.09.2000)

Date of mailing of the international search report

17 OCT 2000

Name and mailing address of the ISA/US

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